MOBILISING MARKET-BASED INSTRUMENTS FOR CLIMATE CHANGE IN IRELAND

Lisa Ryan, Frank Convery and Noel Casserly

Abstract

As regards climate change, we are facing a carbon constrained world where 'do nothing' is not an option. Our national targets and mechanisms have come to us from the European Union. The European Union Emissions Trading Scheme (EU ETS) has created scarcity in the market place for the power and heavy industry sectors, and they face a price signal per tonne of CO_2 ('allowance') that tells them that reduction at a cost per tonne below the market price will be profitable, and increased emissions will cost. The response as to how to deal with this situation is left entirely up to the firms involved. This flexibility is crucially important to support innovation and competitiveness. The European Commission's proposals for EU ETS post 2012 include auctioning of allowances – in particular in regard to the power sector – and centralisation of cap-setting. We support these proposals.

Very demanding targets are now proposed by the Commission for the non-trading sector (agriculture, transport, waste, heat and process related emissions from residential, commerce and industry not in the trading scheme), to be achieved by 2020. This EU-originating target should supersede the national target set in the Programme for Government of an 86 per cent reduction from 2007 by 2010. We propose that the same flexibility and support for innovation that exists for the trading sectors apply also to the non-trading sectors, achieved by the immediate introduction of a carbon levy to reach the level of the allowance price in the EU ETS, with the revenues used to: reduce other taxes (40 per cent), address fuel poverty (30 per cent) and further support reduction in greenhouse gas emissions (30 per cent). The latter should be focused on the least cost opportunities and research and development. The levy on transport might later be replaced by an individualised cap and trade scheme. If the costs of abatement at the margin are substantially higher in the non-trading sector, then some flexibility between the trading and non-trading sectors should be sought from the European Commission. Time is not on our side, so action in Budget 2009 is important.

1. Introduction

The excessive emission of greenhouse gases is a manifestation of market failure which arises as a result of the public good nature of greenhouse gas emissions. In a well-functioning market resources are allocated efficiently[1] but well-defined property rights are necessary for this to occur, which is generally not the case with public goods such as greenhouse gas emissions.

The essence of markets is that they clear – a price emerges that brings demand and supply into equilibrium. If demand increases and supply does not, then the market price rises to bring them into equilibrium. If supply increases and demand does not, then the price falls. The market fails when a price does not emerge that reflects relative scarcity. This is typically the case with environmental endowments. They are often not 'owned' and as use intensifies, no price signal emerges to alert consumers to use them more parsimoniously, or bring use into balance with assimilative capacity. In regard to climate change, we emit gases into the atmosphere that warm the globe, and we do not get a price signal telling us that the capacity to assimilate these gases without the risk of substantive adverse effect is limited and is being overused.

This paper is about ways in which we correct for market failure by creating a price that signals scarcity, and what the implications are for fiscal and budgetary policy. Specifically, we address two choices: limiting quantity of emissions, and allowing trading amongst emitters, thereby producing a price, or introducing the price directly in the form of a tax per unit of pollution emitted.

2. Market-based Policy Instruments for Greenhouse Gas Mitigation

Although historically the most common instrument implemented in the area of environmental policy has been command and control policies, these have been found to frequently be inefficient. Standard regulation can be statically inefficient in that it may not achieve environmental objectives at minimum cost, and it may be dynamically inefficient, since there may be no incentive for polluters to continually improve. In latter years demand-side market-based instruments such as taxes, green subsidies, and emissions trading have become more popular, as they provide an incentive to continually improve environmental performance at least cost. The revenue generated by market-based instruments can provide a double dividend if they are used to reduce other taxes which may be slowing economic growth[2] or creating inequity in society.

There are several features that distinguish greenhouse gas emissions from other problems. First, the pollutants act globally and, therefore, a successful abatement strategy requires a large majority of emitting countries to cooperate and abate, which complicates the political implementation of policy measures. Additionally, CO_2 emissions[3] are mainly a direct result of

[1]We may define efficiency in terms of Pareto optimality, which is the situation where we are unable to reallocate resources without making at least one person worse off.

[2]An example is the eco tax in Germany where a tax was levied on fossil fuels and the revenue was used to reduce labour taxes.

[3]There are six groups of greenhouse gases listed under the United Nations Framework Convention for Climate Change and CO_2 emissions are estimated to be responsible for 60 per cent of the 'greenhouse effect' (www.UNFCCC.org).

the combustion of fossil fuels and, therefore, are essentially a by-product of the industrial world. Abatement is different to that of other pollutants since end-of-pipe abatement of greenhouse gas emissions is expensive and, therefore, modifications to the combustion process are usually necessary, such as improvement in energy efficiency or fuel switching. However, this kind of abatement can provide side benefits, since more efficient combustion also saves the operator energy or fuel costs, and may also reduce other pollutants. A third feature of greenhouse gas emissions is that the consequences of abatement or lack of it will not be felt in the present but in the future.

In an ideal world the optimal emissions abatement level can be estimated by comparing the marginal cost and marginal benefit of the best available abatement technology. However, there is generally great uncertainty with respect to the shape and position of the marginal benefit and marginal abatement cost curves. Often the abatement costs are not known to the policymaker, due to incomplete information on abatement technologies. In many cases also the technology has not been fully developed and, therefore, the future costs of abatement may not yet be known even to the manufacturer. The marginal cost of abatement curve may be neither smooth nor linear, since abatement technologies may be much more costly for increasing abatement levels. Furthermore, as private agents are not faced with the full social costs of greenhouse gas emissions, the private damage costs usually do not equal the social damage costs. It may be very difficult to estimate the damage costs, both social and private, since the cost function in the real world is most likely non-linear and dependent on the number of 'victims', time, pollutant composition and perhaps location (Sterner, 2003). An important consideration in the estimation of greenhouse gas emissions costs is uncertainty regarding the future concentration of greenhouse gases in the atmosphere as a result of current emissions, and the implications. The intertemporal dimension adds complexity to the issue since it is not certain what the impact of any given greenhouse gas concentration will have on future global and regional climates. Weitzman[4] poses the intellectual and empirical challenge when catastrophe is a possibility:

> *Societies and ecosystems whose mean ambient temperature has changed in the geologically instantaneous time of two centuries or so by 11c-20c are located in terra incognita, since such high average temperatures have not existed for hundreds of millions of years and such a rate of global temperature change might be unprecedented even on a time scale of billions of years. Standard conventional Cost Benefit Analyses (CBAs) of climate change do not come even remotely close to grappling seriously with this kind of potential for disasters. When comprehensive CBA includes plausible, if unknown, probabilities of (and plausible, if unknown, damages from) catastrophic climate change, the policy implications can be radically different from the conventional advice coming out of a standard economic analysis that essentially ignores this kind of potential for disasters.*

[4]Weitzman, Martin, 2008. "On Modelling and Interpreting the Economics of Catastrophic Climate Change", Harvard University May 2008.
See: http://www.economics. harvard.edu/faculty/weitzman/files/REStatModeling.pdf

Standard environmental economics textbooks tell us that the optimal level of greenhouse gas emissions abatement is at the point where the marginal abatement cost is equal to the marginal damage cost. In the case of optimal regulation, the pollution standards could be set to the optimal level. Similarly, if a policy instrument of taxes or charges were preferred, the charge would be set at optimal t*[5] to produce the optimal abatement level or if a system of permits were implemented the quantity of permits issued would be equal to the same emissions level. So, theoretically at least, under ideal conditions the optimal abatement level can be achieved with either a tax or permit-based system.

In the real world, conditions are rarely ideal and policymakers must settle for a second or even third best policy solution. This is because, even if it were possible to estimate the optimal abatement level, there are often political constraints related to the implementation of the first best policy selected using the criteria above. Particular conditions, for example the socio-economic situation, information availability and structure, technology availability, environmental problem at hand, and political system demand different policy instruments.

Our perspective takes as given the European Union policy framework in which we find ourselves in Ireland in 2008. This is far from what many economists would regard as optimal if we could design and implement policy from a *tabula rasa*. Going back to Weitzman (1974), there is a literature which makes the case for the use of environmental taxes rather than emissions trading as a means of addressing climate change. There is also a very convincing case that, on grounds of both economic efficiency and environmental effectiveness, if emissions trading is to be used, it should apply to all emissions. Our reality is that there is no EU-wide greenhouse gas tax and little prospect of same, and the emissions trading scheme is only partial in coverage.

Given this context, the next sections describe the market-based policy options available for Ireland and outline their potential to efficiently and effectively reduce greenhouse gas emissions while improving competitiveness and social equity. The first of these approaches is called 'emissions trading' to which we now turn.

3. Emissions Trading in Ireland

In Annex A, we discuss what emissions trading is, the context and pressures which produced a European Union Emissions Trading Scheme (EU ETS) for carbon dioxide, the main greenhouse gas, how it has been implemented and how it has operated in terms of price effects, abatement, creation of markets etc. Readers who are not familiar with trading in general, and the European scheme in particular, should read this annex before proceeding.

The questions that are interesting to address in regard to Ireland's performance and potential vis-à-vis EU ETS include the following:

[5]When the charge or tax is set at the intersection of the marginal abatement cost and marginal damage cost the tax is referred to as a Pigouvian tax.

How well did Irish companies adapt to the market over the 3 year pilot phase in terms of transactions, and in accessing allowances from a variety of sources?

Are utilities in Ireland capturing surpluses in the form of price increases that reflect the cost of allowances, but getting the allowances mostly for free?

If so, should there be an attempt to use the tax system to capture some or all of such surpluses?

Are there changes proposed for the system that Ireland should support or oppose?

Is there evidence for, or a prospect of, competitiveness issues, nationally or sectorally?

If a carbon tax is introduced, should it apply to those in the trading scheme?

Taking each of these in turn:

Trading Performance of Irish Companies in the European Union Emissions Trading Scheme (EU ETS) during the First (Pilot) Phase, 2005-2007.

The net balance in volume and cash terms is shown in Table 1 below:

Table 1: Net Balance in Allowances over the First (Pilot) Phase, EU ETS, Ireland

Year	Average Price Per Tonne €	Net Volume	Net Value
		000 Tonnes	000 €
2005	20.6	406	-8,373
2006	16.6	-229	3,797
2007	0.6	733	-440
Total	5.5	911	-5,016

Source: Community Independent Transactions Log (CITL).

For the whole period, Ireland had a net expenditure of just over €5 million and net purchases of 911,000 tonnes, at average cost per tonne of €5.50. There were net sales in 2006, when prices were relatively high, and the largest net purchases took place in 2007 when prices were at their lowest. In EU ETS, installations receive their annual allocations in February, but do not have to balance their account for the previous year until April, which means they can *de facto* borrow allowances, and many seem to have borrowed forward to avail of the much cheaper allowances in 2007. We can conclude that, overall, companies were either lucky or good, or perhaps both, at reducing the costs of meeting their commitments.

As regards selling allowances, this happened in the context of an overall short situation.

ELECTRICITY PRICE PASS THROUGH

For the pilot phase, the Commission on Energy Regulation (CER) only allowed the marginal cost – the cost of the net purchases of allowances – to be passed on to consumers. However, the situation changed in regard to the second phase (2008-2012) and thereafter. This is in the context that, overall, utilities were left short in the sense that allocations were lower than historic emissions in this second phase.

A good sense of the key issues and challenges for the future can be discerned by examining the Environmental Protection Agency (EPA) publication, *Ireland's National Allocation Plan Second Consultation*, October 2 2007,[6] which applies to the 2008-2012 period.

The total quantity of allowances to be allocated in the period represents 87 per cent of forecasted emissions in that period. Of the total 9 per cent has been 'held back' to cover new entrants. This provision in the EU scheme is controversial, as it is held by some to *de facto* discriminate in favour of polluting incumbents, on the following basis: a new entrant who proposes to build an emission-free plant will get no allowances, while an incumbent who wishes to develop a new plant with emissions can use the asset value of their existing free allowances to get cheap credit for the expansion, and get the additional emissions 'covered' by receipt of more free allowances.

A total of 22.262 million allowances annually are allocated. This compares with 22.32 million annually allocated in the first period, a reduction of less than one per cent. Holders are capped as regards the extent to which each installation can meet their needs using linking mechanisms to 12, 11, and 1 per cent respectively in the power generation, cement and general sectors. Only 0.5 per cent of allowances will be sold, "to defray the expenses of administering the emissions trading scheme".

There are over 100 installations included, and we can divide them into power generation, cement, and the rest. The bulk of allowances go to electricity generating stations and cement plants. (See Annex Table 1 for top 17 installations, ranking based on proposed allocation for 2008-2012.)

All 12 electricity installations have been allocated 68 per cent of their 'relevant emissions', the latter comprising mainly their historic emissions (with 2003 as the key year in this regard), or their projected emissions. It is assumed that the contribution of renewables grows from 4.3 per cent in 2003 to 15 per cent in 2020 and 33 per cent by 2030, and this expectation was accounted for in making allocations to the powergen sector.

The companies involved will need to bridge whatever gap exists between their free allocation and their prospective emissions by a combination of abatement, fuel switching, purchase of allowances, and purchase of project-based credits from Joint Implementation (developed countries) or Clean Development Mechanism (CDM).

[6]http://www.epa.ie/downloads/pubs/air/etu/name,23524,en.html

With the emergence of the all-island electricity market, it is clear that generators in this new market will be expected, as a condition of their generation licences, to bid into the all-island wholesale market at prices that fully factor in their short-run marginal costs (SRMC) for each half-hourly dispatch period. Such costs explicitly include the full opportunity cost[7] of EUAs for each half-hour period,[8] a provision which did not apply during the pilot (2005-07) phase. It is likely that any 'must run' status peat-fired stations would be allowed to include any Public Service Obligation (PSO) subvention as a negative marginal cost.

However, the overall bidding principle of SRMC is quite clear. Under this system, electricity consumers will pay at least some of the opportunity-cost value of allowances, even where the utilities have not had to pay for them. It is important from an environmental performance point of view that households will face and experience the costs of emitting CO_2 into the atmosphere associated with their consumption of electricity. It is also appropriate that the charge will vary depending on the carbon intensity of electricity generation. Under a system where permits are issued without cost to the electricity companies, it was the pass through of the opportunity cost of free allowances in the pilot phase that encouraged Germany, the UK and Italy to auction a significant proportion of their allowances (up to 10 per cent is allowed under EU ETS regulation). But Ireland is only selling 0.5 per cent of its allocation, so there is not a direct substantial flow to the Exchequer.

Where does the public interest lie in regard to the pass through? Pass through encourages reduction in electricity consumption, and should be allowed; it confronts the consumer with the marginal costs of abatement. But should the government claw back some or all of this pass through to the extent that it occurs as 'unearned' profit by the company?

In considering this issue, it is useful to distinguish between the State-owned Electricity Supply Board (ESB) and the rest. The ESB is the dominant incumbent, with a proposed allocation over the five year phase 2 (2008-12) period of 38.5 million tonnes of CO_2, which is just over two and a half times the allocation to the rest of the utility sector.

ESB

The value of the pass through to the ESB is estimated for two scenarios – assuming a price of €23 per tonne and pass through of 50 per cent and average price of €25 – and pass through of 70 per cent – is shown in Table 2. The total value for the five year second phase is €438-668 million range.

[7]'Opportunity cost' is the value foregone in using an asset and is independent of whether one paid for it or not. Thus, an allowance in EU ETS for delivery in 2008 is today trading at €26.00 per tonne of CO_2. If – as will be the case in Ireland – emitters get these valuable allowances for free, they will still recognise their full value as they make decisions. Just because an indulgent aunt gives you a house for free, you do not give it away or rent it for free – you recognise its full opportunity cost.

[8]See: All Island Project – the Bidding Code of Practice – A Response and Decision Paper AIP-SEM 07-430, 30 July 2007. We are grateful to Neil Walker for alerting us to this document.

Table 2: Estimated Value of Pass Through of CO_2 Price Accruing to the ESB, Two Scenarios, 2008-12

Operator Name	Location	Proposed Annual Allocation (2008-12) Million Tonnes	Value of Price Pass Through Scenario 1[9] Million €	Value of Pass Through Scenario 2[10] Million €
1. ESB	Moneypoint Powergen	3.735	42.95	65.36
2. ESB	Poolbeg Powergen	1.536	17.66	26.88
6 ESB	Tarbert Powergen	1.001	11.50	17.50
14 ESB	Aghada Powergen	0.526	6.05	9.20
15 ESB	Lanesboro Powergen	0.512	5.89	8.96
17 ESB	North Wall Powergen	0.325	3.74	5.69
Total Annual		7.635	87.79	133.59
Total 5 years 2008-12		38.175	438.95	667.95

Since the ESB is wholly government owned, as a shareholder it should in any event benefit from any surplus. However, the policy context is rapidly evolving. In July 2008, the Commission on Energy Regulation (CER) welcomed the joint announcement by the Spanish utility Endesa and the ESB that the former was purchasing a number of ESB power generation stations as part of the Commission's CER-ESB Asset Strategy Agreement aimed at reducing ESB's share of the power generation market to 40 per cent by 2010. On March 27, 2008, the ESB and the government announced a major investment programme, whereby between now and 2020, €22 billion will be invested, including networks (€11 billion) that will facilitate the development of 6,000 MW of wind power island wide development on its own account of 1,400 MW of wind power investment in energy efficiency, including smart metering. The ESB proposes to halve its carbon emissions within 12 years, delivering one-third of its electricity from renewable generation, and achieve carbon net zero by 2035. It seems likely that some of this investment will correct for market failures e.g. in energy efficiency via smart meters, and that there is a case for allowing all of the value of the pass through to be held by the company to help fund this investment However, it is important to formalise the analysis to see that such is the case. This would also help decide what policy should be in relation to the surplus likely to accrue to the other companies.

Other Utilities

A similar logic applies to the other utilities. The aggregate surplus accruing over 5 years is estimated to fall in the €174-269 million range (Table 3). The CER has been struggling to encourage sufficient capacity to provide competition to the ESB, so there may be reluctance to impose requirements on those new entrants who have come into the market. However, this needs to be balanced by the fact that consumers are providing them with a gain for which they have not paid, and a *quid pro quo* is appropriate, perhaps with a focus on energy efficiency. The Kema (2008)

[9]Assuming average price per tonne of CO_2 of €23, and – following Sijm *et al.* (2006) – an average pass through of 50 per cent. Example for Moneypoint: Annual pass through equals 3.735 million x 23 x 0.5 = 42.95.

[10]Assuming average price per tonne of CO_2 of €25 and an average pass through of 70 per cent. Example for Moneypoint: Annual Pass through equals 3.735 million x 25 x 0.70 = 65.36.

analysis of energy efficiency enhancing opportunities in Ireland makes the point (p.30) that :

> *It is clear that electricity offers the most significant potential for energy savings (greater than those of oil and gas combined). This reflects both the nature of electricity use in society and also the losses associated with its generation.*

Table 3: Estimated Value of Pass Through of CO_2 Price Accruing to the Other (non ESB) Utilities, Two Scenarios, 2008-12

Company	Facility	Proposed Annual Allocation Million Tonnes	Value of price pass through Scenario 1[11] Million €	Value of Pass Through Scenario 2[12]
8 Viridian Power	Huntstown, Finglas Powergen	0.806	9.27	14.1
9 Synergen	Ringsend Powergen	0.768	8.83	13.4
10 Tynagh Energy	Tynagh Co Galway Powergen	0.739	8.5	12.9
11 Huntstown Power Co.	Finglas	0.721	8.29	12.62
Total		3.034	34.89	53.1
Total over 5 years		15.17	174.43	265.5

TRADING POST 2013

The European Commission has presented proposals for the EU ETS from 2013 to 2020 (the third phase) and thereafter. The key features are:

- Cap tightening – stepwise reduction of total allowances by 20 per cent by 2020.
- Centralisation ('harmonisation') of – cap fixing, allocation, monitoring verification and enforcement.
- Auctioning of allowances, with focus on the power sector.
- Leakage provisions for the non-power sectors – more free allowances and/or 'equivalent effort' required of imports to EU.
- Banking (including Certified Emission Reductions (CERs) from CDMs that are already in the second phase ERs) over 13 years – 2008-2020.

[11] Assuming average price per tonne of CO_2 of €23, and – following Sijm *et al.* (2006) – an average pass through of 50 per cent. Example for Moneypoint: Annual pass through equals 3.735 million x 23 x 0.5 = 42.95.

[12] Assuming average price per tonne of CO_2 of €25 and an average pass through of 70 per cent. Example for Moneypoint: Annual Pass through equals 3.735 million x 25 x 0.70 = 65.36.

- CERs post 2012 parked pending UN agreement.
- Exclude small-scale installations (but require "equivalent effort"?).
- Effort sharing – distribute 10 per cent of auctioned allowances to poorer Member States.

These measures are to be welcomed for a number of reasons:

Auctioning will remove the advantage which free allocation gives to incumbents. It will also generate revenues which will accrue to the member states and can be used *inter alia* to reduce other taxes, intensify carbon reduction effort elsewhere and provide support for poorer people who are particularly disadvantaged by higher prices.

The long period of banking and borrowing will allow smoothing of the market thereby reducing price swings.

Innovation in new carbon reducing technologies will be stimulated by the longer time horizon, the more stable prices and the guarantee that there will be an immediate cash payoff to reductions.

The ESB's strategy of investing in carbon reducing technologies will have the commercial benefit to them of reducing the volume of allowances that they will need to buy to cover their emissions, to the point that they may become exporters of allowances.

COMPETITIVENESS ISSUES

No significant issue in this regard has arisen during the pilot phase, with net outgoings being less than would be paid for an acre of land in Dublin's city centre.

Short Term (2008-2012)

There are short-term issues in the second period arising from the free allocations. When low carbon competitors come into the Irish market, it is crucial that the incumbent advantage of free allocation not be allowed to disadvantage such new entrants.

There is a systematic tendency for the non-utility firms to be treated generously. Excluding cement, their emissions are small: generally a lot less than 100,000 tonnes annually. Those of some significance as regards volume are the Conoco Phillips Whitegate Refinery (Relevant Emission of 372,094; allocation 389,164), Bord na Móna briquette factories at Derrinlough (relevant emission 68,343; allocation 71,478) and Littleton (relevant emission 67,180; allocation 70,261), Diageo Dublin (relevant emission 70,681; allocation 73,924).

Each of the four largest cement installations received 96 per cent of their relevant emissions, based on a pro rata allocation of the sectoral envelope. If the construction industry grows, and cement holds or grows its share, then these firms – CRH and Quinn – will have to buy allowances to cover their emissions at the margin. Conversely, if construction declines and/or they lose market share, then they could end up with more allowances than they need, and be able to sell these in the market place.

Longer Term (2013-2020)

While allowances to the utility sector will be auctioned, the issue of auctioning allowances for the non-utility sectors in the scheme is left more open, depending in part on the credibility of the evidence regarding competitiveness issues. Going forward, the Commission proposes a two step approach. Identify the extent to which such issues are relevant at the sectoral level. If there is evidence of negative competitive effects, two possible solutions – requiring 'equivalent effort' from companies selling into the EU, in the sense of buying allowances to cover the emissions that were emitted, or giving European producers free allowances. These options are currently being debated.

CARBON TAX AND TRADING

The firms in the trading scheme have shown that they can adapt to the market. They are faced with a price signal in the Euro 20-30 range that tells them 24 hours a day, 365 days a year, that, if they reduce emissions at a cost below this level, they can sell the allowances released at a profit. It would be redundant and economically inefficient to apply a carbon tax to those in the trading sector, for the following reasons: individuals and firms adjust at the margin to approximately make the costs and benefits at the margin equal, and diminishing returns sets in – the more you do, the more expensive it becomes. Efficiency for a particular objective is maximised if the returns at the margin across all the abators is equal. So we recommend that the carbon tax only be applied to those not in the trading scheme. The scale of the challenge, in terms of meeting the Commission's target of a 20 per cent reduction in the non-trading sectors is clear from the Table below.

Table 4: Emissions from the Non-Trading Sector in 2005, and Hypothetical Targets for 2020 to Meet the EU Cap

Sector	Emissions in 2005 Million Tonnes of CO_2 Equivalent	Per Cent of Total	Target if Each Sector Reduced Pro Rata by 20 Per Cent in Tonnes of CO_{2e}	Reduction Needed in Million Tonnes of CO_{2e}
Agriculture[13]	19.6	41.3	15.7	-3.9
Transport	13.0	27.4	10.4	-2.6
Residential (non-electric only)	6.9	14.6	5.5	-1.4
Service Premises (private offices and public buildings)	2.9	6.1	2.3	-0.6
Waste	1.8	3.8	1.4	-0.4
Other (industry not in EU ETS, tourism etc.	3.2	6.8	2.6	-0.6
Total	47.4	100	37.9	-9.5

[13]Most emissions from agriculture and waste are methane.

Note that this scenario assumes that emissions in 2020 will equal those in 2005, which is a highly conservative assumption.[14] But even with this context, we have to squeeze almost 10 million tonnes of emissions out of the system over 12 years, in a context where emissions from agriculture only reduced by 0.7 million tonnes (from 20.3 to 19.6 million) over the 1993-2005 period, and emissions from transport rose by 7.2 million tonnes (from 5.8 to 13.0 million) over the same period.

What role can a carbon tax play in meeting this challenge? This is the topic to which we now turn.

4. Carbon Tax in the Non-Trading Sectors

A carbon tax is a tax on the emissions of carbon or carbon dioxide and is a favoured instrument for economists to reduce CO_2 emissions due to its cost-effectiveness. Unlike international oil price rises, which benefit foreign producers, the revenues from carbon taxes can enable other taxes to be reduced, vulnerable households to be helped and the energy-efficiency of their homes to be upgraded.

As with all market-based instruments the relative increase in the cost of emitting carbon coaxes people to adjust their habits to dearer energy. The goal is to ultimately reduce carbon emissions by sending a price signal to businesses and consumers so that they change their behaviour. By giving users the choice to either reduce their emissions or to pay the tax, carbon taxes are cost effective since generally firms and users with the least abatement costs undertake abatement first. There is also dynamic efficiency, as carbon taxes incentivise firms to invest in technological innovation that will allow them to continually improve their emissions reductions. Inventors of clever ways to reduce energy use now face customers whose interest is enhanced by the true value of the savings that efficiency will bring them.

Carbon taxes are a price-based instrument, compared with emissions trading which is based on emissions quantities.[15] There are advantages and disadvantages to both in their implementation but theoretically, if emissions permits are auctioned in perfect market conditions then both instruments can be equivalent. As with all policy, it is the design of policy measures which determine their success or failure under the usual criteria of static and dynamic economic efficiency, environmental effectiveness, socio-economic impacts, and political/public feasibility.

Taxes on income and labour have a tendency to discourage work while taxes on pollution discourage pollution. Therefore, raising the same amount of revenue but via more pollution taxes and lower labour taxes helps make the economy more efficient while lowering pollution. Aggregate taxes do not rise but they are raised in a smart manner. Similar arguments can be made for emissions trading systems where emissions permits are auctioned and the revenue used to reduce other taxes. There

[14]Recent EPA projections suggest that in 2020 the non-ETS sectors will generate 53.3, 52.0, and 44.9 Mt CO_2 under their baseline, "with measures", and "with additional measures" scenarios respectively.

[15]In the cap-and-trade version of ETS, a cap is set on the total emissions permitted from the sectors included in the scheme.

are now several Member States with Environmental Tax Reform (ETR) in place and the COMETR project has carried out an ex-post assessment of the experiences of seven EU Member States with ETR and finds that there are largely positive effects (see Box 1).

The Programme for Government agreed in July 2007 states that: Appropriate fiscal instruments, including a carbon levy, will be phased in on a revenue-neutral basis over the lifetime of this Government. The environment subgroup of the Commission on Taxation was established in March 2008 …to investigate fiscal measures to protect and enhance the environment including the introduction of a carbon tax.

A carbon tax has been discussed in the Irish context repeatedly since Fitz Gerald and McCoy first explored the options for implementation of a carbon tax in Ireland in their seminal paper in 1992. Further work was carried out subsequently on the impact of a carbon tax on the Irish economy (Bergin *et al.,* 2004; Smith, 2003; Wissema and Dellink, 2007; Fitz Gerald *et al.,* 2008; and Tol *et al.,* 2008) and examining the distributive effect on households (Scott and Eakins, 2004; Tol *et al.,* 2008). The Department of Finance considered the introduction of a carbon tax in 2003 and opened a public consultation on the issue.[16] Subsequently, a report was produced summarising the 117 submissions and in September 2004 the Minister for Finance, Charlie McCreevy, announced that the carbon tax would not be implemented. The reason given was that …*the environmental benefits would not justify the difficulties that would arise, particularly for households, from the introduction of such a tax*. There was insufficient political will to implement a policy with such a high level of public unpopularity.

Box 1: Evidence from Other EU Member States

The COMETR project examined the experience of six countries on the issues of competitiveness, carbon leakage, mitigation, and compensation with respect to Environmental Tax Reform (ETR). The study concludes that while the environmental taxes implemented were "relatively modest", they have contributed to greenhouse gas emissions reduction of between 1.5 and 6 per cent in 2004 compared to business as usual. It is estimated that by 2012 the effect will comprise a reduction of up to 7 per cent below the outcome without the tax reform. In addition it is calculated that the tax reform has produced a modest but significant positive effect on economic growth. This has arisen because carbon taxes have led to energy efficiency gains and lower wage costs.

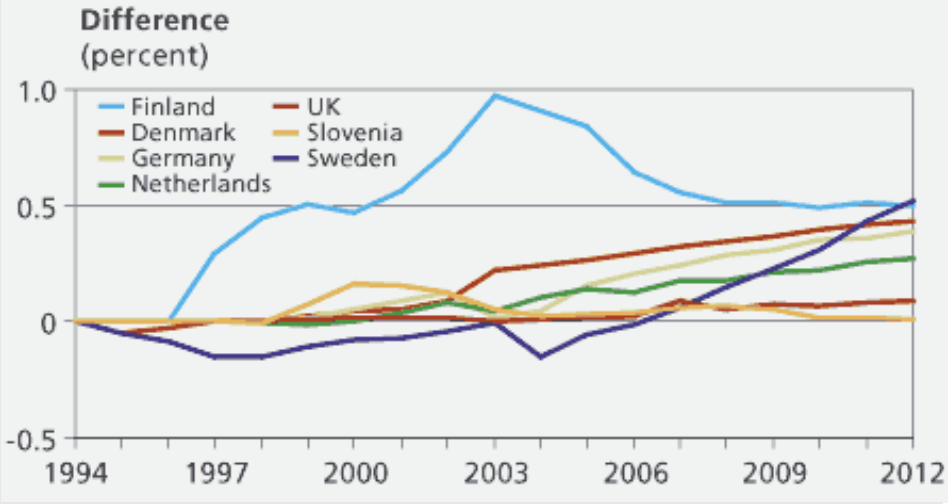
The study found that there are winning and losing sectors under the reform and that overall there has been an economic advantage for five of the six countries studied. In the UK the reform was found to have a neutral effect on the economy, but it was noted that the scale of the tax rates levied there has been modest and it is also the most recent environmental tax reform.

It appears to make a difference whether energy prices or taxes increase. The main reason for this is that with energy price rises the additional revenue does not return to the public domain but is exported whereas domestic taxes can be used to lower other taxes. In addition, domestic

[16]http://www.finance.gov.ie/viewdoc.asp?DocID=1778

taxes are not levied on non-fuel imported raw materials and intermediate goods and this can have implications for firm competitiveness.[17]

Figure 1: The Effect* of Green Tax Reform (ETR) on Economic Growth



*The effect is measured as the difference between the baseline and the reference case of ETR. Slovenia has not introduced green tax reform, but has adjusted energy taxes in the industrial sector according to CO_2-content.
Source: Cambridge Econometrics.[18]

A Commission on Taxation has been re-formed in 2008 with an environmental subgroup to examine again the potential introduction of a carbon tax and it is interesting to consider how to resolve the perceived obstacles from 2003. The following concerns are often raised in arguments against a carbon tax:

- Not effective in terms of CO_2 emissions reduced – while energy prices have risen over the past years, energy consumption has also risen;
- Most of industry is already part of the EU ETS and carbon taxation would lead to double taxation;
- Reduction in industry competitiveness;
- Issue of fuel poverty among low income households;
- Inequitable burden on rural dwellers due to high price of transport fuels.

Carbon taxation is a contentious issue, particularly in a world of high energy prices. An important argument in its favour is our high level of greenhouse gas emissions and the fact that we have legally binding commitments under European Union law which are proving expensive to meet. In the last budget the government set aside €270 million in addition to the previous €20 million in 2005 in order that the government be able to

[17]COMETR website http://www.dmu.dk/International/News/Archive/2007/CO2tax.htm. The full report is available on the COMETR website http://www2.dmu.dk/cometr/
[18]Ibid.

purchase up to 18 million tonnes of carbon allowances over the period 2008-2012. This assumes a purchase price of approximately €15/tCO_2 emissions; if this price rises appreciably or Ireland requires even more allowances to meet rising emissions, then the amount required to buy credits could become significantly higher. As noted earlier, these obligations are expected to become more demanding post 2012. Instead of raising general taxes on all taxpayers to buy out our obligations, it makes sense to face every emitter with the cost of their emissions, and encourage them automatically to reduce. This is fair because those who emit most pay most, and it is efficient because the abatement response is left to the emitter.

LEVEL AND TIMING OF THE CARBON TAX

In the Programme for Government, there is a commitment to reduce emissions to 86 per cent of 2007 levels by 2010. Since this commitment was agreed, the Commission has proposed that Ireland's emissions from the non-traded sector be reduced by 20 per cent by 2020, perhaps rising to 30 per cent in the event of international agreement. We propose that this Commission target should supercede the programme for government commitment for the following reasons: it ensures consistency between Irish and EU policy, and it allows more time for government business and households to bring forward and implement reduction strategies that are cost effective.

When should a tax be introduced, and at what level? Greenhouse gas emissions continue to rise in the non-trading sectors and policies are needed with immediate effect that begin to arrest this trend and raise awareness as soon as possible. Therefore, the carbon tax should be implemented forthwith, modified if necessary thereafter to ensure consistency with the Commission for Taxation's proposals. A carbon tax could be phased in, starting with the budget for 2009, initially at a low level, to give businesses and households time to adjust, rising to approximately equal the price of carbon in the emissions trading market so that all sectors are equally treated. This is estimated to be about €25/tCO_2 in 2012. It takes 3-5 years for most of the incentive effects of a carbon levy to be reflected on the ground and therefore, the tax could be introduced now, even at a low level.

SCOPE OF THE CARBON TAX

We agree with Tol (2007), Tol *et al.* (2008) and Fitz Gerald *et al.* (2008) that sectors already included in the ETS should be exempt from the carbon tax. The scope of the EU ETS is fixed for now and unlikely to be extended to other sectors in the near future. Although most allowances were grandfathered to the sectors in the EU ETS, there is evidence to suggest that carbon prices will be passed through to consumers and, therefore, as discussed in the previous section we do not propose that ETS sectors be liable for a carbon tax. It can be expected that the cost to firms in the ETS of 'acquiring' permits will mean the cost of using permits by emitting CO_2 and these costs will be passed through to consumers even if extra permits are not purchased. As noted, it is proposed that allowances in EU ETS be auctioned from 2013. While the tax in principle should cover all of the non-traded emissions, there would be difficulties in implementing such a tax to diffuse non-point sources, such as agriculture. So we propose that the tax initially apply to the rest of the non-traded sectors – transport,

residential, services, waste industry not in EU ETS – with a separate 'equivalent effort' provisions to apply to agriculture.

Concerns with social equity should be addressed through the use of revenue from the tax and we will discuss this in a later section.

POTENTIAL CO_2 EMISSIONS REDUCTIONS

A study by Kema (2008) for Sustainable Energy Ireland focused on opportunities to achieve energy efficiency in the residential, commercial and industrial sectors. It identifies substantial economic potential for carbon savings in electricity, oil and gas, where 'economic' is defined as "those measures that are cost effective under current conditions."[19] It does not address agriculture and transport, and does not distinguish between the traded and the non-traded sectors. Estimates of the costs and potential for emissions reduction are also found in ICF Byrne Ó Cléirigh (2006) in their analysis of the marginal costs of abatement prepared for the Department of the Environment, Heritage and Local Government as background for the development of the National Allocation Plans for EU ETS. Their analysis does recognise the distinction between trading and non-trading sectors, and includes agriculture and transport. Although they are difficult to compare, because of the different focus and scope, the ICF Byrne Ó Cléirigh analysis seems to be much more conservative as to what can be achieved at what cost. An estimate of the impact of a carbon tax of 20€/tCO_2 on emissions from the non-trading sectors excluding agriculture was included in the Comhar SDC submission to Budget 2008. CO_2 emissions reductions were estimated using long run (3-5 years) elasticities and resulting CO_2 percentage changes for households (-3.1 per cent) and industry (-4.3 per cent) from ESRI, road haulage transport using elasticities from Bjørner, (1999) (-0.1),[20] road transport (cars) (-0.17) from Ryan *et al.* (2007)[21] and it is assumed that the elasticity for service premises is equal to that of industry. This led to estimated savings of 469kt CO_2 emissions based on 2005 values, which is similar to the 500kt estimated in the Department of Finance consultation document produced in 2003.

The literature in this area has examined the impact of different carbon price levels on Irish CO_2 emissions. Bergin *et al.* (2004) found that a carbon tax of €20/tCO_2 emissions would not reduce emissions sufficiently to meet Ireland's target in 2012 of 13 per cent emissions increase compared with 1990 under the EU burden-sharing agreement. However, Wissema and Dellink (2007) find that a carbon tax of approximately €10-15/tCO_2 would result in a reduction of 25.8 per cent compared with 1998 levels, which would achieve Ireland's 2012 target. More recently FitzGerald *et al.* (2008) and Tol *et al.* (2008) find that a carbon tax set approximately equal to the emissions trading price, i.e. €20/tCO_2 in 2012 and €38/tCO_2 in 2020 would reduce CO_2 emissions from the non-ETS sectors by a modest amount

[19] Amounting to 3.759, 1.868 and 0.714 million tonnes of CO_2 respectively.

[20] Bjørner, T.B. (1999). "Environmental Benefits from Better Freight Transport Management: Freight Traffic in a VAR Model," *Transportation Research D*, Vol. 4, No. 1, January, pp. 45-64.

[21] Ryan, L., S. Ferreira, and F. Convery (2007). "The impact of fiscal and other measures on new passenger car sales and CO_2 emissions intensity: Evidence from Europe", ongoing research.

(523kt) and would not achieve the proposed 2020 CO_2 emissions target. However, these are in part a function of the use to which the carbon tax revenue is put, which is the subject of the next section.

The announcement of the introduction of a carbon tax has an important impact on reducing carbon emissions in advance of the actual implementation of such a scheme. In the UK, study of the impact of the climate change levy (CCL) shows that there is a much stronger "announcement effect" than "price effect" on emissions reductions.[22] They estimate that the announcement effect of the CCL on its own (i.e. without price effects from the imposition of the CCL) caused a reduction in energy demand from other final users of 4.0 per cent in 2001, then 8.4 per cent in 2002, and this is expected to rise to 13.8 per cent in 2010. This includes the feedback effect of lower demand causing lower electricity prices, which reduced the announcement effect's impact. The modelling work described above regarding an Irish carbon tax does not include any additional effects such as the "announcement" effect and therefore, it may be that the introduction of a carbon tax in Ireland would have a stronger impact on CO_2 emissions than the models have indicated.

Box 2: UK Climate Change Levy and Agreements

In the UK a climate change levy was announced in 1999 and implemented in 2001. We have examined this levy for comparison with a potential carbon tax in Ireland. First, there is a fundamental difference in that the UK climate change levy is only applied to industry, commerce and the public sector. It does *not* apply to fuels used by the domestic or transport sector, fuels used for the production of other forms of energy (e.g. electricity generation) or for non-energy purposes; it also does not apply to energy used by registered charities for non-business uses, and energy used by very small firms.[23] The levy is not charged as a function of the carbon content of fuels but is levied directly on the energy type. Businesses that are part of the climate change negotiated agreements and who meet their energy reduction targets are eligible for an 80 per cent rebate in the climate change levy. Businesses that are part of the negotiated climate change agreements are also eligible to join the emissions trading scheme to buy allowances beyond their target. In this way firms either meet their agreement target through their abatement efforts or by purchase of emissions allowances and pay 20 per cent of the climate change levy, or they do not and pay the tax.

[22]Cambridge Econometrics (2005). "Modelling the initial effects of the climate change levy". Available at http://customs.hmrc.gov.uk/channelsPortalWebApp/channelsPortalWebApp.portal?_nfpb=true&_pageLabel=pageImport_ShowContent&propertyType=document&columns=1&id=HMCE_PROD1_023971#P15_3004 [Accessed 8/10/2007]

[23]Rates of levy are 0.15p/kWh for gas, 0.98/kg (equivalent to 0.07p/kWh) for liquefied petroleum gas (LPG), 0.44/kWh for electricity and, 0.12p for any other taxable commodity. The levy is expected to raise around £1 billion in its first full year (2001/02). The levy package is expected to lead to reductions in carbon dioxide emissions of at least 2.5 million tonnes of carbon a year by 2010. http://www.defra.gov.uk/environment/climatechange/uk/business/ccl/intro.htm [accessed October 8, 2007].

REVENUE USE

The *Medium-Term Review* estimates the CO_2 emissions from the non-traded sector in 2010 to be approximately 28 $MtCO_2$.[24] This equates to a revenue stream of around €550 million (for a carbon tax of €20/tCO_2) and is forecast to grow annually by between 7.2 per cent and 8.2 per cent, depending on whether all greenhouse gas emissions are included or just CO_2 emissions and whether ETS permits are auctioned. Therefore, the revenue from a carbon tax is expected to be significant and there are several options for its use. The Programme for Government states that the carbon levy or tax should be revenue neutral which means that the revenues from the levy should be recycled back to the citizens – taxes should not be increased but rather the tax base shifted in favour of carbon emission reducing activities, or the money should be returned. How exactly this is done is a key determinant of (a) environmental performance, (b) economic competitiveness, and (c) public acceptability. The latter is becoming increasingly important in the face of rising energy prices. There are three broad categories of use for carbon tax revenue generally discussed – hypothecation for investment in environmental activities, macroeconomic adjustment such as a reduction in labour taxes, and finally, compensation to households for distributive effects.

The first option is to recycle some or all of the revenues from the carbon tax to the different sectors in approximate proportion to their payments, and in manners that further intensifies and incentivises actions to reduce emissions and to address some of the equity and competitiveness concerns associated with a carbon tax. In general, economists prefer that the revenue from environmental taxes not be set aside or hypothecated for greenhouse gas emissions saving activities. The argument is mainly that it reduces the flexibility of the government budget and also that if an activity is not worth subsidising from the national budget then it is also not worth subsidising with the carbon tax revenue (Tol *et al.,* 2008). The latter point assumes that government already has in place a system for the efficient allocation of public expenditure. There is the risk that if significant funds are earmarked for investment in specific activities then they may be wastefully spent in order to "use up" the funds.

However, there are some advantages associated with a decision that some of the carbon tax revenue should be invested in further greenhouse gas emissions savings activities. The experience of Sustainable Energy Ireland through the pilot negotiated agreements programme with industry in 2002 showed that the emissions savings were almost doubled if a carbon tax was linked with an industry agreement providing energy-saving expertise and services. There is a case to be made that there may currently be underinvestment of the government budget in public good activities such as energy technology R&D, centres providing expertise and advice to firms in energy efficiency and other greenhouse gas emissions mitigation and adaptation activities, which are of little commercial value at this time. In addition, investment in developing alternative energy sources such as renewable energies may reduce the burden of the carbon levy in the long run.

[24]Note that the emissions forecast is calculated including a carbon tax and, therefore, the emissions have been adjusted to take this into account.

Another significant advantage of investment of the revenue in the sectors that have paid the taxes is that it is likely to increase the public acceptability and hence, political feasibility of implementing a carbon tax. There is also a fairness aspect; if all the revenue is spent on individuals' income tax reductions and welfare benefits, then it might be argued that business sectors facing the carbon tax such as road haulage, services sectors etc. also deserve a share of the revenue directly.[25]

There may be a case for using some of the revenue to increase stakeholder buy-in to a carbon tax scheme and also to maximise the greenhouse gas emissions savings that could be achieved through investment in public good activities such as provision of centres of expertise etc. In order to identify the best means to utilise the revenue in each sector, the government could engage with each sector to identify expenditure within the sector that will further reduce emissions. This is consistent with the partnership model that has worked well for Ireland, and should encourage 'buy in' as well as increasing the effect on emissions reduction yielded by the incentive effects of the levy alone. The key requirement of any sectoral agreement would be that it significantly and cost-effectively further reduces emissions. While we do not argue that all carbon tax revenue should be spent on investment in climate change-related activities, we believe that more government spending is needed in certain public good activities relating to climate change and that a portion of the carbon tax revenue could be used to fund this. Further study is needed to examine the gaps in current spending and to assess the amounts needed to develop opportunities and technologies to reduce greenhouse gas emissions cost effectively. Regular review would be needed of the amounts spent to ensure efficiency. The Kema (2008) and ICF Byrne Ó Cléirigh (2006) analyses provide contrasting menus of opportunities which need to be investigated further to identify (a) the hierarchy of reduction opportunities that exist, ranked on the basis of cost effectiveness, (b) the government or market failures that are inhibiting the take up of these opportunities and (c) the role, if any, of public expenditure in facilitating abatement.

Another option is to use the funds to reduce other taxes and charges, e.g. PRSI, or to provide a lump sum rebate to households. Classical ETR protagonists favour the use of environmental tax revenue to lower other taxes such as on labour. Since carbon tax raises prices and therefore the cost of living too, it would normally be expected that wage demands would also rise. Therefore the revenue from carbon tax could be used to offset some of the increased costs people face by for example reducing income taxes, social insurance contributions, or giving a lump sum to all households. This could be done in line with the Agreed Programme for Government, which has the stated goal of reducing PRSI at 2 per cent to 4 per cent over the term of government. However, the programme also plans to raise the ceiling on PRSI rates so that PRSI can be levied on all income in which case the additional revenue raised would cover the reduction in rates. Wages on the other hand have risen in Ireland significantly over the last years with 5.5 per cent growth in 2007 and exceed that of many of our trading partners. While the Spring ESRI *Quarterly Economic Commentary*

[25]Although they would benefit indirectly through stable wage demands as a result of the income tax reduction.

forecasts this to decrease over 2008 and 2009 to 4 per cent and 3.5 per cent respectively (Barrett *et al.* 2008), the use of carbon tax revenue to reduce labour costs further could be significant in improving Ireland's competitiveness.

The *Medium-Term Review* and Tol *et al.* (2008) model the effect of different uses of revenue on the economy and CO_2 emissions. They compare the impact of using carbon tax revenue to invest in health and education, reductions in income tax, social insurance or national debt, distribute lump sums to householders, and buy permits internationally. They find that investment in health and education has the largest positive effect on GNP and employment but that in the long run causes a reduction in the output of the private sector due to crowding out by the public sector. A reduction in income tax is beneficial to the economy and employment, however, only those who have a taxed income are included and therefore, other mechanisms such as increased welfare benefits would also need to be included for those not in the tax net.

Scott and Eakins (2004) and Tol *et al.* (2008) examine the impact of a carbon tax on household income and find that it is regressive as expected,[26] the lower income deciles of the population spend a higher share of their incomes on fuels. Scott and Eakins (2004) considered various forms of compensation[27] to lower income households and found that a strategy which delivers lump sum compensation to the bottom five income deciles of the order of the average annual expenditure on carbon tax (estimated at €246) would be best. They also recommend setting aside approximately €50 million for energy efficiency enhancing schemes such as house insulation and fuel switching. There were an estimated 100,000 households or 6.5 per cent of the population in 2005, who went "without heating at some stage during the year" because they could not afford it.[28] It costs on average €1,000 to install attic or wall cavity insulation in a home (which improves energy efficiency by 20 per cent); therefore, a significant budget is required to perform this task in all homes classified as at risk of fuel poverty.

The modelling work by Fitz Gerald *et al.* (2008) and Tol *et al.* (2008) estimates that the increased cost of living due to the carbon tax could be fully compensated by reducing labour taxes and increased welfare benefits with 65-80 per cent of the revenue, leaving 20-35 per cent of the revenue available for other uses. From this it seems that there is scope to make room for use of the revenue for both macroeconomic and greenhouse gas emissions mitigation benefits. In line with the literature discussed here, we propose that 40 per cent of carbon revenues be utilised to reduce income taxes, 25-30 per cent be used to compensate lower income households, and the remaining amount be invested in public good activities to reduce greenhouse gas emissions in the affected sectors.

[26]Interestingly, Scott and Eakins find that while a carbon tax would be regressive for expenditure on residential fuels, expenditure on transport fuels as a share of disposable income is highest for middle income families and, therefore, may need some form of compensation for the increased costs.

[27]In particular they investigated VAT reduction and different strategies of lump sum compensation.

[28]CSO (2006). EU Survey on Income and Living Conditions (EU-SILC) 2005.

CAP AND SHARE SCHEME

An alternative to a carbon levy has been proposed in some quarters as a 'Cap and Share' scheme (c&s) for some or all of the non-trading sectors, whereby each citizen would be given an allowance allocation, with the total of such allocations amounting to the desired cap.[29] Essentially, the scheme would operate similarly to a carbon levy but would address the problem of public acceptability since the cap is placed on upstream emissions. There is a significant difference between the carbon levy and a cap and share scheme in terms of the revenue use. Whereas a carbon levy would generate revenue to the Exchequer, a cap and share scheme effectively awards each citizen the revenue associated with average per capita greenhouse gas emissions. Comhar SDC commissioned research in 2007 on c&s as a policy instrument to reduce greenhouse gas emissions from Irish residential and transport sectors which are not covered by the EU emissions trading scheme. Both represent a significant source of greenhouse gas emissions in Ireland, making up 10.7 per cent and 19.4 per cent respectively of Irish greenhouse gas emissions in 2006.[30] At the time of writing AEA Technology have completed a qualitative analysis of the scheme and this section is based on that work; further modelling analysis is ongoing with Cambridge Econometrics.[31]

Cap and share is an idea proposed in Ireland by the Foundation for the Economics of Sustainability (FEASTA) which is based on the argument that each individual should get an equal share of the benefits from the limited amount of fossil fuels that will be burned and the associated greenhouse gas emissions released to the atmosphere.[32] Accordingly, a cap would be set for the greenhouse gas emissions emitted by primary fossil fuel suppliers to the sectors included in the scheme and certificates issued to all adults entitling them to an equal share of the emissions permitted under that year's cap. These certificates could then be sold to the fossil fuel suppliers via an intermediary such as a bank or post office. By capping emissions upstream the price of emissions is built into the price of fossil fuels which are passed through to the consumer. The consumer has an incentive to use less fossil fuel than the average amount for which he is compensated through the sale of the certificates. There are no examples in other countries of such a scheme in operation.

A simple example may better illustrate how this scheme works. The government decides the level of a cap on emissions from fuels supplied to the household and transport sectors. This amount of emissions is divided

[29]FEASTA report, 2006. *Using Cap and Share to control emissions from the EU transport sector.* Available at http://www.feasta.org/documents/energy/Transport_emissions_in_EU_proposal2.pdf. More information at www.capandshare.org

[30]EPA (2008). "Ireland's Emissions of Greenhouse Gases for the period 1990-2006". Available at http://www.epa.ie/downloads/pubs/air/airemissions/name,23960,en.html

[31]The qualitative analysis is available in the interim report at http://www.comharsdc.ie/publications/index.aspx

[32]Progress of the cap-and-share idea can be traced through various papers published by FEASTA on their website. Contraction and Convergence was the original concept and Richard Douthwaite worked with Aubrey Meyer over 12 years up to about 2005 developing it and also producing a Schumacher Briefing on it. http://greenbooks.co.uk/store/product_info.php?cPath=33&ref=159&products_id=184&osCsid=7b2ef78582fa1fe15fdaa88cc3689cfe

equally between all citizens and each citizen is sent a certificate representing credits for the average amount of CO_2 emissions. Fuel importers now come under the emissions cap upstream and are required to buy emissions credits from banks; they then pass-through the cost to consumers. The consumers, facing this extra cost, bring their certificates to the intermediary, maybe a bank, and cash in the whole amount or perhaps just enough to cover their current expenditure while withholding the rest in the belief that prices may rise in the future. They are encouraged to reduce their CO_2 emissions to minimise their exposure to the increased fuel costs.

DESIGN ISSUES

Scope

The Cap and Share scheme could in principle apply to the whole economy as a means of driving down emissions in all sectors. However, in practice there would be interactions with existing measures and it may be desirable to focus on certain emitting sectors.

Emissions from the transport sector represent the largest growing source of CO_2 emissions and this suggests that the focus of a Cap and Share scheme could be emissions from the transport sector. The benefits of restricting the scheme to the transport sector would be a focused move towards a more sustainable transport system, and provide the opportunity for learning before any further expansion. The advantages of wider initial implementation would be economies of scale and the opportunity to understand more about the interaction between the scheme and the wider economy. A second further area of potential coverage is domestic use of energy, although the EU ETS does already regulate emissions from the electricity sector.

Equity

There are winners and losers with all price-based carbon emissions schemes. With the Cap and Share scheme these effects would be no more significant than any other mechanism that places a cost on carbon emissions and again it is the design of the scheme that will determine the extent of the effects. The effects in general are similar to those described above for a carbon tax combined with lump sum compensation for all citizens. Under c&s lower income households, on average, would benefit since they have lower than average energy consumption and would receive emissions certificates worth more than the increased fuel costs they incur. However, due to variability within income bands, some low income households would be worse off, and may be less able to find energy savings or absorb increased costs compared with their wealthier counterparts.

Those living in rural communities could also be disadvantaged, relative to those in towns and cities, because they are likely to need to travel greater distances for basic amenities. They would also have less access to low carbon public transport alternatives to using a car. Also, the distribution of certificates to single-person households may not fully compensate them for the increased costs they would incur.

There are a number of possible ways to address these equity concerns. The preferred approach would be to address them through alternative measures, such as increases in the Children's Allowance, the domestic

heating allowance or funding for public transport. These measures could be funded through general taxation or through the auction of a proportion of the emissions allowances. If the national budget were used this would decouple the revenue through carbon emissions from investments in environmental activities, as recommended for the carbon tax above. However, in this case extra revenue may be required and, therefore, general taxes may have to be raised. Reducing each individual's allocation for the purpose of auctioning could be seen to worsen the issue as lower income groups would be compensated less than before. A further possibility would be to allocate more to those who would otherwise stand to lose, although this would appear to undermine the principle of the scheme.

Population Coverage

A register of eligible individuals could be complied through a combination of the electoral roll and the Personal Public Service number system, to capture the majority of people residing in Ireland.

A question on the treatment of children arises, since they are consumers of energy but not necessarily purchasers. Literature regarding personal trading schemes generally suggests not allocating allowances to children, although consideration would need to be given to the age at which individuals are treated as an adult for the purpose of the scheme. Consideration should also be given to other mechanisms to support families regarding the increased carbon costs. Less favoured alternatives would include partial allocation to children or allocation on a household basis (Starkey and Anderson (2005), Dresner and Ekins (2004), DEFRA (2006)).

Short stay visitors would not be included in the scheme, although longer stay residents that register for a PPS number should be included. If this were the case then consideration of eligibility or something similar would be needed in order to avoid exploitation of the scheme by visitors who receive and sell certificates and then leave.

Institutional Arrangements

A Government body would need to be responsible for setting the framework, the objectives and dealing with any policy issues. The Department of Environment, Heritage and Local Government, as the department responsible for climate policy, would be the most likely choice. Cap setting could either be carried out by Government or an independent body. In either case, however, the cap should be consistent with the national target in the National Climate Change Strategy and the strategy it sets for individual sectors.

The scheme would need to be run by a single administrative body. This would ensure consistent accountability for all aspects and clarity from the perspective of participants. It would also ensure the effects of any changes to approach could be managed throughout the process. The Environmental Protection Agency, as scheme administrator for the EU ETS, would be the logical choice. It could also draw on its experience from being responsible for the National Emissions Inventory. The responsibilities of this body would be to: maintain the register of fuel suppliers; define the standards by which emissions must be reported and

verified and produce guidance documents; and maintain the trading registry.

In addition to the above activities there would be a number of other functions for which the scheme administrator must maintain an overview but which may be carried out by other bodies. These would include: maintaining a list of participating individuals and issuing them with certificates (for which the Department of Social and Family Affairs would have a role); determination and verification/audit of emissions (for which Customs and Excise would have a role); market regulation and; training and capacity building.

Transaction Costs

The costs of designing the Cap and Share scheme in relation to other measures would in general be higher than introducing a carbon tax. For the Cap and Share scheme the cost of administering the fuel suppliers is likely to be secondary to the costs associated with issuing certificates to the general public.

The cost to the members of the public is very sensitive to a number of design issues. The simple bottom up estimate of AEA Technology, which included the value of people's time, puts the transaction costs for a system where certificates are cashed in remotely in the range 8-11 per cent of the value of the certificates. This range depends on income and assumes an allowance price of €20/tCO_2 and a bank direct transaction charge of 5 per cent. At higher carbon prices the relative cost effectiveness would be better, with transaction costs around 6-7 per cent for a price of €50/tCO_2. However, if participants were required to cash in allowances in person then the costs could be significantly higher. To minimise transaction costs for individuals to a level that will be considered acceptable consideration would need to be given to the following:

- Allowing on-line and postal facilities for converting certificates.
- Minimising the amount of material that an individual must understand, possibly making use of passive media such as television and radio broadcasts.
- Allowing individuals to delegate the authority to cash in allowances.
- Simplifying the requirements on banks and post offices to minimise their costs and the changes that they may charge for transactions.
- Considering the cost impacts when deciding whether to distribute certificates more frequently than yearly.

Finally, the administration costs to those industries that would be required to register, trade and surrender allowances would be small in comparison with the costs to Government and the general population as a whole.

Legal Aspects

On legal aspects the European Commission is unlikely to prohibit the scheme on the basis of it constituting State aid, primarily because the scheme as a whole would not give rise to a net benefit to any commercial

undertakings. However, cases that may have relevance to Cap and Share where State aid has been upheld have been identified in the AEA Technology report. Therefore, it was not possible to be fully conclusive on this issue. Similarly, internal market rules should not be prohibitive.

CAP AND SHARE CONCLUSIONS

Overall, this research has outlined a number of key design issues relating to the Cap and Share scheme, and suggested possible ways forward. In particular:

- A cautious approach would suggest initial implementation for the transport sector only, with subsequent consideration to sectoral and geographical expansion.
- But note that the cap and share approach involves transferring the value of allowances directly to the citizenry, i.e. compared to the carbon levy, no revenue accrues directly to the Exchequer.
- The scheme is not inherently inequitable, but measures would be needed to shield the vulnerable from increased costs.
- The scheme should be based on the PPS system and electoral role, with consideration given to the treatment of children. Evidence suggests not allocating to children, although again consideration will be needed for increasing support to families.
- The roles of various institutions have been suggested, with a key element being the scheme administrator that would have an overview of the whole scheme.
- Transaction costs to individuals can be acceptably low, provided they can cash in their certificates remotely (on-line or by post).

5. Discussion and Conclusions

We are facing a carbon constrained world, where our ability to use the atmosphere to dispose of greenhouse gas emissions in limitless quantities for free no longer applies. 'Do nothing', or 'let the others do it' is not available as an option. In practical terms, the constraints we face come to us from our share of the European Union's commitments, and these come in two forms: the power sector and heavy industry (cement, refining, glass and ceramics etc.) which are already in the European Union Emissions Trading Scheme (EU ETS), and the rest – the non-traded sectors – comprising agriculture, industry not in EU ETS (heating and process energy only), households (heating only), transport, commerce, waste.

As regards the trading sectors, the evidence we have from the pilot phase is that Irish participants in the EU ETS have managed their obligations with considerable skill, and they are likely to continue to do so. Since they already face a carbon price, we recommend no further policy intervention, and we conclude that it would be inefficient and counterproductive to include them in a taxation scheme. For the period 2008-12, the utilities will capture an 'unearned' gain, as they will be able to pass through most of the value of allowances for which they have not paid. We support the pass through, but the fiscal issue arises – should a windfall gain tax be imposed to capture some of this gain over the 2008-12 period? We propose that such a tax not be imposed, but only on condition that the

utilities demonstrate that they are undertaking activities that are in the wider public interest, such as funding the installation of time of day meters. The definition of 'the ESB' is changing as the organisation divests itself of generating capacity to meet the regulator's requirements. The company has announced a major investment programme focused on grid development, renewable and efficiency measures. The specific payoffs to the public interest need to be documented, and related to the subsidy implicit in the pass through. The same principle should apply to the other utilities. The Commission proposals for the 2013-2020 period are to auction allowances, at least for the power sector, with the revenues accruing to the government; we support this proposal.

As regards the non-trading sectors, the European Commission has proposed a legally binding cap on emissions of minus 20 per cent by 2020 compared with 2005 emissions. The challenge we face in Ireland is how best to meet these targets at minimum cost, and in fashions that encourage new business and innovation, and that are fair. Additionally, energy prices are very high with uncertainty regarding future prices and this already provides an incentive to reduce our energy consumption. We strongly favour the use of market based approaches, which allow maximum flexibility which in turn will minimise costs and will also allow encourage innovation. They also make use of other policies such as regulation of building standards, and information on the environmental performance of cars and buildings, to operate more effectively.

Using command and control regulation to meet this very stringent target would likely be extremely demanding as regards administration and bureaucracy, and very inefficient as regards the burden on the economy because of loss of flexibility. So we are left with the need to introduce a price that signals scarcity but allows a flexible response. There are two broad options: apply a carbon levy that incentives reduction, or create a trading market that caps emissions, and allows participants to buy and sell. The advantages of the levy are as follows: it is easy to implement, with minimal transactions costs; it generates revenues that are then available for re-cycling for some combination of reduction in other taxes, supporting further reductions, and helping vulnerable groups adjust to the price changes – the annual revenues of applying a levy at roughly the rate that reflects the price of allowances would amount to about €0.5 billion annually; it has been done in other countries, so we have experience to draw on as regards reduction responses and economic impacts. Disadvantages are that particularly in a world of high energy prices it evokes public and sectoral opposition, the mitigation of which may require 'side payments' in terms of revenue recycling, and uncertainty as regards emissions reductions.

As regards creating a local trading market in what is now the non-trading sectors, we are at present exploring the potential for a cap and share scheme, whereby a cap is decided upon, individual citizens are given allowances where the sum of such allocations does not exceed the cap. Up-stream suppliers of energy will have to buy allowances from the citizenry to cover their emissions, and these costs will be factored into the price of their energy supplies. This price will increase to the point where demand and supply are in equilibrium. The advantages of this scheme are that: it gives each citizen an asset which has value in the market place, and establishes an identity between the citizen and meeting the climate change challenge, and

compensates him or her for the rise in fuel prices – to the extent that one can control emissions, either a net profit (value of allowances exceeds rise in fuel bill) or loss is incurred; it ensures that the target is met. It is very difficult to quantify this sense of ownership and identity, but it is likely to be important in mobilising public understanding of the climate change issue, and support for measures to address it. The disadvantages are that: the transactions costs of setting up and operating the scheme are considerable, because it is new and so there is uncertainty as to how it would work in practice; it does not generate revenues for government, and the inevitable demands for 'special case' compensations would have to be funded out of general taxation. If the cap and share scheme were to be used, it seems that it would be most appropriate in the transport sector, where constraining emissions is especially difficult.

Our recommendations are that the carbon tax be phased in immediately for the non-trading sectors exclusive of agriculture at rates approximately comparable to the price of allowances faced in the trading sector, with revenues used to support a national programme of fuel poverty reduction, to support further reductions in emissions where it is clear that (a) the benefits of doing so exceeds the costs and (b) the market on its own will fail to achieve such reductions, and to fund research and development and innovation that enhances business opportunities in energy efficiency, abatement and adaptation. There is some confusion in the evidence available as regards the energy efficiency and abatement opportunities and their cost in Ireland. These need further interrogation and updating so as to ensure that policy and funding can be directed towards the least cost mix of strategies.

If, as seems to be the case, that the marginal costs of abatement in the non-trading sectors are much higher than that which prevails in the trading sectors, this asymmetry will impose an economic drag on the economy – we will end up spending more resources than necessary to achieve any given overall combined reductions from the trading and non-trading sectors. This is a weakness of the dichotomy between trading and non-trading in EU climate change policy. Achieving some flexibility between the two pillars – doing more in the trading sectors, and less in the others – would enhance cost effectiveness and competitiveness.

If the research underway indicates a clear advantage to cap and share in the transport area, the levy on this sector should be removed and replaced by the cap and share mechanism. We note that agriculture, which accounts for almost half of the non-trading sector emissions, will not be included in either scheme at present, as its main emission is methane from livestock. A separate parallel abatement strategy is needed for this sector.

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ANNEX A: TRADING AND THE EUROPEAN UNION EMISSIONS TRADING SCHEME

The European Union has pioneered the development and implementation of the European Union Emissions Trading Scheme (EU ETS), the world's first trans-national greenhouse gas trading scheme.[33] The EU ETS gives a price signal that penalises increased emissions and rewards reductions for those sectors and organisations in the scheme.

The EU ETS involves making allocations of tonnes of carbon dioxide (CO_2) emissions (called European Union Allowances or EUAs) per year to installations, with the proviso that at the end of the year, they must 'hold' sufficient allowances to cover their emissions in this period. In order to meet this condition, if they are short of allowances, they can enter the market and buy from others who have more than they need ('long'). A price per tonne of CO_2 emerges from these trades, which represents in some sense a cost to emitters of the scarce capacity of the atmosphere to absorb this greenhouse gas. If they can reduce emissions, they can sell those allowances that are surplus to requirements into the market; if they are short, they have to buy in order to cover their requirements. This price signal, therefore, constitutes a continuing incentive: reduce and you will be rewarded, increase and you will have to pay. The EU ETS is sometimes critiqued because it is not 'as good as' a carbon tax, and/or that particular design features are perverse and inappropriate. In the context below, we show that a tax is not politically feasible, and the design features of EU ETS in the short run are a product in part of the political necessity, where the choices come down to achieving an imperfect carbon price signal versus none at all.

[33]Details available at: http://ec.europa.eu/environment/climat/emission.htm. See discussion on characteristics and performance in: Frank J. Convery and Luke Redmond "Market and Price Developments in the European Union Emissions Trading Scheme," Review of *Environmental Economics Policy* 2007, Vol. 1, No. 1, pp. 88-111.

A1. Context

The context of this development is the following[34]: Following the Rio Environment and Development Conference in 2002, at which the European Commission had pressed for quantitative caps on greenhouse gas emissions, it brought forward a proposal for a European Union (EU) wide carbon energy tax. This was universally opposed by the various industry lobbies, epitomised by UNICE, the European Employers Federation with which the Irish Business and Employers Confederation (IBEC) and their equivalents in the other member states are affiliated. A number of member states also opposed the tax on principle. Since fiscal measures require unanimity, the initiative failed, and was formally withdrawn in 1997. There may be circumstances under which an EU-wide tax would be politically feasible, but it is difficult for us to imagine this as a realistic policy choice.

At the negotiations on the Kyoto Protocol in 1997, the US delegation insisted on including emissions trading as a flexible measure, and prevailed in spite of strong opposition from the European Union. In 1998, the Commission had a change of heart; the team which had failed to secure the carbon tax was now given a lead role in the development of climate change policy, and charged with progressing an EU-wide emissions trading scheme. Commission support was achieved in part because of the Single market and associated competitiveness concerns; the UK and Denmark had initiated their own (quite different) national trading schemes, and there was a fear that the environmental market would be balkanised, with many trading schemes with different rules, and associated potential for inhibition of trade and high transactions costs. Also, over time, it became clear that 'business as usual' would probably not achieve the Kyoto target (EEA, 2002), and there was no other Europe-wide policy measure that was likely to deliver a change in the emissions trajectory.

However, the EU ETS concept was initially vigorously opposed by Germany industry and government on the basis that they had already a voluntary agreement and did not need another policy layer dictated by the Union. Some business elsewhere in Europe was in favour, but argued for a voluntary scheme. Unlike the carbon tax proposals, the EU ETS was proposed as an environmental measure, and, therefore, only required a qualified majority vote by the Member States to secure legal approval. However, there was reluctance to proceed without a degree of German support, since they emit about 25 per cent of covered emissions. The compromise was to agree, but only on the basis that allowances were allocated for free at member state level, with guidance and final approval from the Commission, with monitoring, reporting and verification also at member state level, and with provision to allow 'opt out' with equivalent effort in the pilot phase and pooling in the pilot and second (2008-12) phases, with both of these features included to meet needs in the UK and Germany. What emerged was not what should be, but what could be. Importantly, a 3 year pilot phase with review was part of the design, so that substantive weaknesses could be identified and corrected on a 'learning by doing' basis.

[34]The contextual material that follows is drawn from Skjaerseth and Wettestad (2008).

A2. Operation

The operation of EU ETS in its pilot phase has recently been assessed in Ellerman and Joskow (2008) and Convery, De Perthuis and Ellerman (2008). What follows draws from these sources.

The EU ETS[35] started its first phase – the three-year pilot phase – in January 2005 and this came to an end in December 2007. We can address coverage, trading, allowance prices, and abatement in the pilot phase.

Coverage: Participation was limited to CO_2 emissions from combustion installations with a rated thermal input in excess of 20 MW (except municipal or hazardous waste incinerators); oil refineries; production and processing of ferrous metals; manufacture of cement (capacity of over 500 tonnes per day); manufacture of lime (capacity of over 50 tonnes per day); ceramics, including brick and glass; and pulp, paper and board (over 20 tonnes per day). On this basis, EU ETS covered over 40 per cent of greenhouse gas emissions in the Union. Why did the coverage go 'down stream'? It is notable that the European scheme does not include road transport, which is recognised as the main source of growth in emissions. This is because excise duties on petrol (gasoline) and diesel are high in Europe [The excise duties on gasoline in Germany is equivalent to €275.20 per tonne of CO_2]. Governments did not wish to risk the loss of this revenue, and environmentalists worried that if trading were substituted for the tax, the environmental achievements of the tax would be compromised.

Competitiveness: Sectoral work shows that, at least in the short run, only sectors not in the trading scheme – and therefore not benefiting from free allowances – but importing electricity prices that reflected in part CO_2 allowance prices, such as smelters, would suffer competitive disadvantage. The *ex post* work supports this conclusion – so far, there is no evidence of negative effects on capped sectors, but high commodity prices and free allocation may mask potential effects.

Allowance Price per tonne of CO_2 per annum: In the pilot period, the combination of member state originating generous allowances, and abatement produced an initial price of up to €30 per tonne, but this fell over time to close to zero at the end of the period as it became clear in April 2006 that the market was over-supplied. The high price at the outset was a product of: willing buyers – utilities who had been left short, and unwilling sellers – the rest of industry, who had been left 'long'; inadequate information – real data on supply demand balance only became available in April 2006; inability to carry forward – bank – surplus allowances to Phase 2 (2008-12).

Allowance value pass-through in Electricity prices: Another feature of the pilot phase of the EU ETS was the 'passing through' in unregulated markets of some of the market value of allowances into electricity prices, even though the allowances were given free of charge. This had the merit of signalling to consumers that they had to pay for the CO_2 emissions associated with their consumption, but provided some utilities – notably those in Germany, the UK and the Netherlands, where the markets were unregulated – with

[35]Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC.

windfall gains. There is evidence that some utilities were capturing significant rents – some being able to pass 40-70 per cent of opportunity cost of allowances through in electricity price. (Sijm, Neuhoff and Chen, 2006).

Abatement: As the pilot phase took off, natural gas prices rose sharply – in the EU they are linked to oil prices – while coal prices did not increase proportionately. In the absence of the requirement for allowances, there was a strong incentive for utilities that could do so to bring relatively carbon intensive coal fired plant on line and move them up the dispatch order. But this required the acquisition of more allowances, which increased the costs of operating this plant, and this in turn in some cases changed the tradeoffs. So the CO_2 market acted as wedge, limiting the extent of the default to coal, the calculus in some cases in favour of less carbon intensive natural gas. Or shifting from lignite (more carbon) to less carbon intensive hard coal. Independent estimates by Ellerman and Buchner (2008) and Delarue *et al* (2008) indicate that annual reductions from the counterfactual of about 50-100 million tonnes of CO_2 were achieved, and this is consistent with the overall performance documented by the European Environment Agency (2007).

Trading Volumes: These grew from 262 million tonnes, valued at €5.97 billion in 2005 to 24.1 billion tonnes, valued at €1,500 billion in 2007.

Allocation: it was mainly free, with only Denmark (5 per cent), Hungary (2.5 per cent), Lithuania (1.5 per cent and Ireland (0.75 per cent) doing any auctioning.

Inter-country Trades: The transfers between member states are maintained by the European Commission in the independent Community Transaction Log (ICTL). The UK and Spain were the big net buyers in the first Phase, while France, the Czech Republic and Poland were the big net sellers. But of course countries per se do not trade. They represent the aggregate of individual firm decisions.

Table A1: Net Purchases and Sales of Allowances, by Value, During the First Phase (2005-07), EU ETS

Country	Net Purchases Million €	Country	Net Sales Million €
UK	-695	France	+285
Spain	-353	Czech Republic	+272
Italy	-294	Poland	+176
Austria	-53	Netherlands	+109

Source: Phase 1 € Matrix, CITL European Commission.

The major net buyers and sellers are presented in Table A1. The major net buyers were the UK and Spain, while France and the Czech Republic were the biggest sellers by value.

A3. The Policy Response

The European Commission reacted to this situation by reducing the allowance allocation by about 6.5 per cent for the second period 2007-2012 and this has tightened up the market, yielding a price for 2008 vintage allowances of over €20 per tonne. A few member states substantially increased auctioning for the 2007-2012 phase, with major countries Germany (8.8 per cent), UK (7 per cent) and the Netherlands (4.0 per cent) leading the way (percentage to be auctioned in brackets).[36] The Linking Directive allows firms to meet some of their obligations by purchasing certified emission reductions achieved in projects in developing countries and other developed countries.[37]

The Commission has tabled proposals for revision of the emissions trading Directive[38] which include*:* cap tightening – stepwise reduction to achieve 20 per cent reduction by 2020; centralisation ('harmonisation') of – cap fixing, allocation, monitoring verification and enforcement; auctioning of allowances (power and...); leakage provisions for the non-power sectors – more free allowances and/or 'equivalent effort' required of imports to EU; banking (including CERs) over 13 years – 2008-2020; new certified emission reductions (CERs) from the Clean Development Mechanism post-2012 parked pending UN agreement; exclude small-scale installations (but equivalent effort?); effort sharing – distribute 10 per cent of auctioned allowances to poorer Member States; central control of any new entrant reserve.

Thus the policy response has been to address the weaknesses that became manifest in the pilot phase.

[36]Ellerman and Joskow (2008), p. 38.

[37]Directive of the European Parliament and of the Council of Ministers amending the Directive establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms - COM (2003) 403 final.

[38]See: footnote 5 above and http://ec.europa.eu/environment/climat/emission/pdf/com_2008_16_en.pdf

ANNEX B: INSTALLATIONS IN THE EU ETS IN THE REPUBLIC OF IRELAND

Table B1: Installations in the EU ETS in the Republic of Ireland

Operator Name	Location	Relevant Emission	Proposed Annual Allocation (2008-12)	Annual Allocation as Per Cent of Relevant Emission
1. ESB	Moneypoint Powergen	5,503,257 (H)	3,735,390	68
2. ESB	Poolbeg Powergen	2,263,394 (H)	1,536,301	68
3. CRH plc	Platin, Drogheda (Cement)	1,560,507 (PR)	1,497,743	96
4 Limerick Alumina Refining	Aughinish (Alumina and Powergen)	1,262,740 (H,P,P)	1,143,865	91
5 Quinn Cement	Co Cavan	1,049,531 (PR)	1,007,319	96
6 ESB	Tarbert Powergen	1,474,055 (H)	1,000,529	68
7 CRH plc	Irish Cement Limerick	890,660 (PR)	854,837	96
8 Viridian Power	Huntstown, Finglas Powergen	1,187,160 (P)	805,796	68
9 Synergen	Ringsend Powergen	1,131,166 (PR)	767,790	68
10 Tynagh Energy	Tynagh Co Galway Powergen	1,089,348 (PR)	739,406	68
11 Huntstown Power Co.	Finglas	1,061,651 (PR)	720,606	68
12 ESB	Shannonbridge Powergen	1,021,370 (H)	693,265	68
13 Edenderry Power	Edenderry Co Offaly Powergen	923,229 (H)	626,651	68
14 ESB	Aghada Powergen	774,301 (H)	525,564	68
15 ESB	Lanesboro Powergen	753,673 (PR)	511,563	68
16 Lagan Cement	Kinnegad County Meath	530,862 (PR)	509,511	96
17 ESB	North Wall Powergen	478,706	324,926	68

H = Historical; PR = Pro rata; P=Projection.