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POLICY OPTIONS TO REDUCE IRELAND'S GREENHOUSE GAS EMISSIONS

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CONTENTS

LIST OF FIGURES

Executive Summary

Owing to the economic recession from 2008 Ireland is likely to meet its commitments for 2008-2012 under the Kyoto Protocol to reduce its greenhouse gas emissions. Nevertheless, the longer term targets that the European Union has set for 2020 are still stringent. Those sectors of the Irish economy that participate in the EU Emissions Trading Scheme (EU ETS) must reduce their emissions by 21 per cent below their 2005 levels. The remainder, and bulk, of Ireland's emissions must reduce by 20 per cent on their 2005 level. In quantity terms, this is a target of some 56 million tonnes of carbon dioxide equivalent (CO_2e) in 2020, compared to the approximately 69 million tonnes emitted in 2007. Forecasting is particularly difficult under changing economic conditions, but on the basis of plausible assumptions, known policies and trends prevailing up to April 2009, emissions in 2020 could be marginally higher than their 2005 level without additional policies and measures. If there is a broader international commitment agreed under the UN Framework Convention on Climate Change, the European commitment will strengthen to a reduction of 30 per cent. Although Ireland's reductions are insignificant in global terms, it can make a promising contribution to global efforts by showing how worthwhile an efficient approach to climate policy can be.

This paper addresses both the political challenge that is faced in moving to a low-carbon state and the economic approaches. The extent and the nature of the issue have not been adequately confronted, as illustrated by the absence of this subject until now from the primary forum for policy agenda-setting, the Social Partnership. At the same time attempts at serious policy change in Ireland have been hostage to sectoral interests that rival the national good. Yet a successful response to the economic and social crises of the 1980s via the Social Partnership suggests that progress is attainable. Three principles will help to guide progress.

- Keep down costs: There are many actions and technologies available for reducing emissions, as seen in estimates of abatement costs. Rather than dictate technologies and sectoral targets, policies that provide a framework to encourage best choices are likely to avoid costly mistakes.

- Charge an equal emissions price: Imposing a price on emissions would rectify the underlying problem, which is the over-exploitation of the Earth's limited absorptive capacity, a scarce but un-priced common resource. The price needs to be the same for all emissions, otherwise some low-cost opportunities for reducing emissions will be overlooked and high-cost alternatives used unnecessarily.

- Control the macroeconomic impact: To achieve such sizable reductions in emissions risks imposing considerable expense on the economy, in macroeconomic terms even. Efficient policies are required that take the overall economic effect into consideration in order to leave Ireland with adequate resources to help vulnerable sectors.

Under these guiding principles, the following approaches to reducing emissions are evaluated:

Legislative approaches: Direct government control plays a role in a balanced set of policy approaches. A legally binding long-term target along the lines of targets passed in California and the United Kingdom could provide political certainty for government departments, private businesses and other stakeholders, although there are doubts about its legal usefulness. The proposed Climate Change Commission foreseen in the National Climate Change Strategy, if sufficiently insulated from political interference, could ensure a continuous review of Ireland's climate performance, by throwing light on costs of emissions abatement and effectiveness of policies and measures and by effecting an open and iterative process of policy coordination, including public participation and submission. Government also has a role in regulating the use of the international flexible mechanisms to ensure that credits are limited to projects that constitute genuine additional reductions. Finally, the State is the largest single landlord with a large fleet of vehicles and bulk purchasing power, and – more so than many private-sector actors – it has the ability to base economic decisions on a long time frame. The public sector should be required to state its emissions, attach a price to them and adopt highest standards, consistent with value for money.

Market- and incentive-based approaches: Fiscal measures, such as carbon taxes, and emissions trading systems are particularly appropriate because they put a price on emitting carbon while allowing actors to respond in varying ways appropriate to their own individual costs of abatement. Abatement costs vary widely, so a framework that automatically encourages low-cost abatement achieves considerable savings. These instruments give a continuous and automatic incentive for the adoption of better abatement technologies. Given that only about 30 per cent of Ireland's emissions are priced (those covered by the EU ETS), coverage should be extended. Carbon taxes have important advantages for achieving this. By setting a credible long-term price on emissions, at a stroke more energy efficiency investments become viable to the would-be investors. R&D is similarly encouraged and revenue is generated. Revenues are most helpful if put towards reducing income or labour taxes to aid the economy's competitiveness, with a share set aside to boost the low incomes of vulnerable households, to ensure fairness. The major disadvantage of carbon taxes is the political difficulty of introducing them, as seen in the decision of 2004 to cancel their introduction in Ireland, and the possibility of political interference generally. Another perceived disadvantage is that some sectors are insensitive to price in the short run, as in transport (which reflects the high short-term abatement costs in this sector), but here additional measures such as road and congestion charging, provision of alternatives by public transport and settlement planning can also play a role.

Trading schemes such as the EU ETS can provide certainty that a specified reduction in emissions will be achieved but the carbon price is uncertain, which discourages would-be investors. Unless the permits are auctioned, the share-out of permits can be unfair and politically manipulated, and can benefit incumbents and encourage poor environmental standards in anticipation. Freely allocated permits still raise prices but give windfall gains to firms. As with carbon taxes, governments should appropriate the gain in order to be able to cushion effects on the economy and the vulnerable according to need. Suggested variants of trading schemes applied at personal level are unlikely to pass on these criteria. Price volatility can be addressed by imposing a floor and ceiling. Such an approach would be applied at EU level and would have to be consistent with linking to schemes elsewhere in the world. Border tax adjustments can address concerns that industries will not be able to compete in trade with countries that do not impose a price on carbon or other environmental constraints.

Border tax adjustments would impose charges on imports, or give reliefs on exports, aligning treatment of traded goods with that of goods made at home. Such measures, which would be applied at EU level and would apply to only a few truly vulnerable sectors, seem to be allowed under international trade rules provided that there is no discrimination. But given the resistance to what could be interpreted as protectionist behaviour, border adjustments should be seen as a last resort in case there is no international agreement.

Standards and regulations: These can be crude, costly and bureaucratic but standards and regulations are helpful in clear instances of market failure, where information is hard to assimilate but benefits (as in buildings insulation) are unquestionable. Information schemes themselves can support regulations as they can catch the imagination and raise understanding and awareness. Eco-labelling and clearer metering can help to overcome barriers to would-be investors. Other areas to address include proper project assessment for infrastructure projects, integrated spatial planning, requiring that extra coal-fired electricity generation be contingent on carbon capture and sequestration, mandating a share of electricity generation from renewable sources, and mandating (and funding) the necessary adjustments to the national grid to facilitate increased penetration of renewable electricity technologies. In general, though, multiple targets can misdirect effort and the first option should be to ensure that carbon emissions are correctly priced.

Subsidies: Subsidies can give incentives to people to invest and behave in carbon-reducing ways. Calls for incentives are in effect calls for more taxation and are often misdirected, for instance subsidies to inappropriate renewable fuels (like biofuels) and subsidies that actually increase fuel usage, requiring further subsidies to rectify the resulting comparative disadvantages. Subsidies for the adoption of new technology do not in themselves reduce emissions and they can be an expensive approach when properly judged in terms of cost per tonne of carbon reduced. One appropriate kind of subsidy is for research and development. The spillovers from R&D and diffusion are positive externalities because these benefits often do not accrue to those engaged in R&D and diffusion.

In conclusion, the policies to apply are those that ensure a long-term credible price applies to all carbon emissions and are accompanied by measures that support society, competitiveness and innovation. But how to implement such a policy mix is still an open question. A major step would be recognition that the framework requires protection from short-term political interference, clearly defined incentives through a price on all carbon, and a transparent, dynamic and fair process with which the public can engage.

1. INTRODUCTION

The resolving scientific consensus about the causes and implications of climate change presents a policy challenge to governments: how to decarbonise economies and adapt them to avoid the worst effects of climate change in an efficient, or at least in a cost-effective, manner. Following internationally accepted principles articulated in the 1992 UN Framework Convention on Climate Change (UNFCCC), industrialised countries are expected to take the earliest action, for which the targets of the 1997 Kyoto Protocol – which expire in 2012 – are seen as a first contribution.[1] In December 2007, at a UN conference in Bali, Indonesia, the international community began negotiations towards a new global climate agreement to deal with the post-2012 period. There are high expectations that an ambitious agreement will be reached at the follow-up UN conference in Copenhagen in December 2009. This optimism is partly due to the election of Barack Obama as president of the United States, who campaigned on a promise to reduce US greenhouse gas emissions to 1990 levels by 2020 and by a further 80 per cent by 2050.[2] This offers the possibility of a renewed engagement by the United States in the international climate regime. Meanwhile the European Council – the regular summit of EU heads of state and government – finalised a unilateral commitment in December 2008 to reduce overall EU emissions by 20 per cent below 1990 levels by 2020; the European Union will extend this commitment to 30 per cent in the event of a global deal with similar commitments by other major industrialised countries. This goal is also seen as a stage in the longer-term aim by developed countries to reduce their emissions collectively by 60-80 per cent by 2050. The common EU position and the improved possibility of a renewed global response sends a signal to stakeholders in Ireland that the debate about climate change has turned from *whether* to act to *how* to act.[3]

The Irish government faces the political challenge of contributing to this ambitious EU goal even though its own emissions have been rising since 1990, the baseline year of the Kyoto Protocol. Ireland may technically meet its commitments up to 2012 – set under an EU agreement at an increase of no more than 13 per cent above 1990 levels – through the effects of the economic downturn and a mixture of limited domestic policies and

[1] The UNFCCC was negotiated in 1992. The 1997 Kyoto Protocol is a subordinate treaty to the UNFCCC.

[2] George W. Bush also campaigned with a pledge to regulate greenhouse gas emissions, although his subsequent jettisoning of this promise was one of the early acts of his Administration.

[3] The European Commission launched a public consultation on the approach the European Union should take on the global post-2012 climate change agreement, following the Commission's Communication "Limiting Global Climate Change to 2° Celsius: The way ahead for 2020 and beyond".

measures and the possible purchase of additional permits via international trading. But the country will require more ambitious domestic policies and measures to contribute to the longer-term targets that the European Union has set for the period to 2020, depending on the timing of the economic up-turn, and certainly for the period beyond.

Climate change is a great and wide-ranging form of market failure (as described in the Stern Review: HM Treasury, 2006). The pricing of global resources (in this case the Earth's atmosphere) does not take appropriate account of the services they provide or their scarcity, and actors in the global economic system can make financial gains from activities that disregard the long-term collective interest of the planet. Such resources that are not naturally subject to anybody's control are prone to the "tragedy of the commons", a well-documented situation where free access and unrestricted demand leads to over-exploitation (Hardin, 1968). As with other kinds of market failure, climate change calls on governments to intervene with policies and measures that benefit society as a whole. Government intervention can correct for the market failure by providing an enabling framework, through legislation, incentives, and above all the predictability of forward planning.

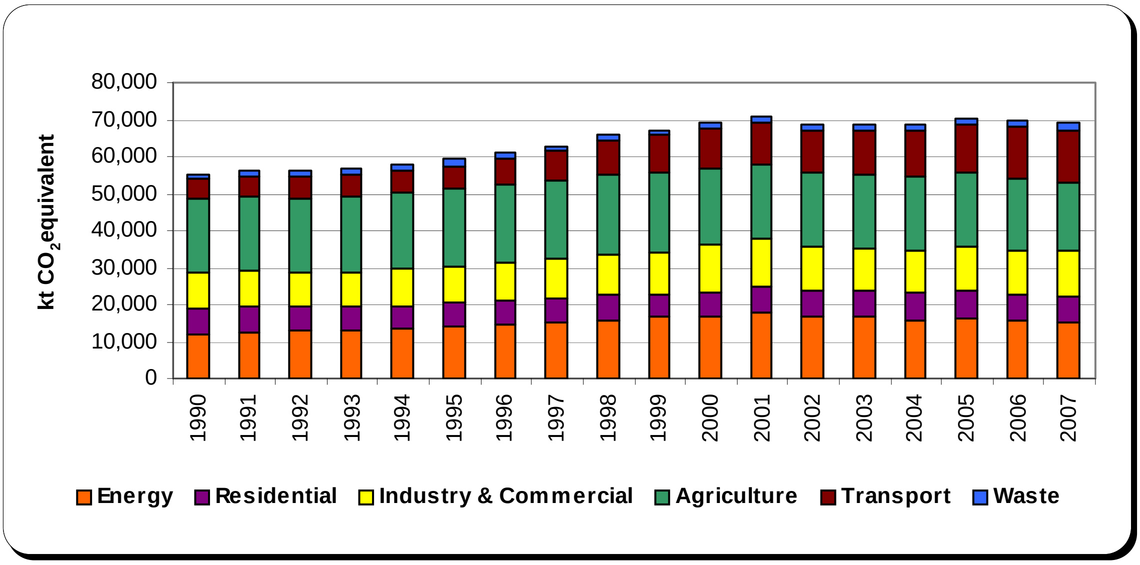
This paper surveys some of the options available to the Irish government to change Ireland's long-term emissions trajectory. We begin by sketching the trends of Ireland's emissions to date and the policies and measures already adopted by governments over the past decade, seeking to place these measures in the political-economic context of decision making in Ireland during the years of rapid economic growth. We survey the main options available to the government, which are legislative measures, market- and incentive-based measures, standards and regulations; subsidies and research and development. We discuss the respective arguments for and against these various approaches. Finally, we set down some basic normative principles that should support climate policy in Ireland in the future, including a minimised cost of reduction (with equal cost per emission reduced), regulatory certainty, clearly defined incentives and a transparent, dynamic and fair process for decision making and policy implementation.

2. TRENDS IN IRISH GREENHOUSE GAS EMISSIONS

The overall trend in Ireland's greenhouse gas emissions has until recently been a fairly steady rise since 1990, the baseline year for most greenhouse gas emissions. The trends up to 2007 broken down by economic sector are shown in Figure 1 (EPA, 2009b). The main exception to the rising trend was the significant but temporary drop in emissions from industry in 2003 due to some plant closures and the replacement of some oil with natural gas for electricity generation. Emissions in 2007 stood at 69.2 million tonnes of CO_2 equivalent (Mt CO_2e) and were nearly 25 per cent above 1990 baseline estimate. The most significant and sustained increase has been in the transport sector, where emissions have increased to over two and three quarters times their 1990 levels, due almost entirely to road transport. Emissions from the energy-industries sector (mainly electricity generation) in 2007 were some 27 per cent above 1990 levels. Although these emissions have declined of late, the commissioning of new peat-fired electricity generating plant has set back some improvements. Emissions in the agriculture sector increased over the course of the 1990s but have recently declined as a result of a reduction in both livestock populations and fertiliser use. Emissions from the residential sector fell somewhat as households shifted from coal and peat to oil and natural gas, but this trend has been countered by recent increases in population and housing stock. Emissions from the industry and commercial sector, following increases to 2001, have stabilised somewhat in recent years. There has been a downward trend in emissions from the industrial and energy enterprises participating in the EU Emissions Trading Scheme (EU ETS), which began in 2005. Verified greenhouse gas emissions from covered sectors have declined from 22.4 million tonnes in 2005 to 20.4 million tonnes reported for 2008.

Taking account of the downturn to date, Ireland may achieve its Kyoto target because of the exceptional economic circumstances. Attention must however turn to 2020, for which the targets have 2005 as their base year. Ireland's emissions can be split into two sectors. Entities with high emissions, consisting largely of electricity generators and responsible for about 30 per cent of Ireland's emissions, are in the EU ETS (discussed in detail in Section 4.2.2. The remaining emitters, termed the non-ETS sector, are responsible for the emissions from all the rest of the economy. Ireland's emissions in the non-ETS sector are subject to a 2020 target fall of 20 per cent on their 2005 level (EPA, 2009a). For the ETS sector there are no specifically national targets but the target for the EU ETS sector overall is

Figure 1: Trends in Greenhouse Gas Emissions by Economic Sector 1990-2007



Source: EPA (2009b).

for a 21 per cent decline on 2005 levels. For the sake of argument, assuming a simple pro rata 21 per cent decline in Ireland's ETS emissions would thus require at least a 20 per cent cut in total emissions by Ireland by 2020. In quantity terms, this is a target of some 56 million tonnes of CO_2e that can be emitted in 2020, compared to the approximately 69 million tonnes emitted in 2007. A longer-term commitment to reduce Ireland's emissions to 80 per cent below 1990 levels by 2050 would require the very challenging target of annual cuts of 4 per cent (see Annex 1).

Economic conditions make forecasting particularly difficult at present but, on the basis of plausible assumptions and current trends, emissions in 2020 could be marginally higher than their 2005 level without additional policies and measures. This would mean that at least a 20 per cent reduction still has to be made on the projected 2020 figure. This is less demanding than the 40 per cent cut that was based on pre-recession projections. This target is nonetheless still very demanding. If, on foot of international co-operation, the European Union adopts the more ambitious 30 per cent cut, Ireland's 2020 target could drop further to some 48 million tonnes. (DEHLG 2007; CEC, 2008; Fitz Gerald *et al.*, 2008). Given Ireland's precarious economic circumstances, policies other than the most efficient ones are not a sensible option.

2.1 A Note on Greenhouse Gas Accounting Methods

The current international approach to estimating emissions calculates emissions that actually occur in the country in question. A country could consume large amounts of imported goods that are emissions-intensive in the making, and these would not be reflected in its accounts; meanwhile emissions from its cattle or its electricity production, though consumed abroad, are included. Guidelines for measuring emissions are consistent if either emissions due to consumption or emissions due to production are counted. Arguably, a more accurate accounting methodology would measure those due to consumption, insofar as the action of using the electricity or eating the meat is what drives the production that causes emissions. This would also avoid misreading emissions patterns due to the movement of dirty industries abroad – a movement known as "carbon leakage". If the emissions embodied in Ireland's imports were calculated[4] and included, and emissions embodied in exports were excluded, some 33 million tonnes of CO_2 were emitted in producing Ireland's imports in 2005, while 11 million tonnes were emitted in Ireland in producing goods for consumption abroad. This casts Ireland's performance in a truer but even less favourable light, and goes some way to explain the strong reduction in the emissions intensity of Ireland's GDP. With emissions based on production, developing countries (which produce and export carbon-intensive goods) could find themselves asked to do proportionately more than their own carbon consumption dictates (Helm, 2008a; IEA, 2008).

[4] For example, as calculated for Ireland in *The Medium-Term Review 2008-2015* (Fitz Gerald *et al.,* 2008). This is sometimes called "virtual" or "embedded" emissions. Figure 5.4 in the *Review* shows carbon dioxide emissions from Final Demand within Ireland, which includes imports.

3. Policies and Principles

Irish emissions have until recently been increasing above Ireland's international commitments and stated domestic policy goals. The present economic downturn, while affording a breathing space, risks masking the underlying trend. This failure is a result of an insufficiently clear strategy on climate change and a lack of a coordinated approach across different government departments and agencies since climate change rose to prominence as a national policy issue. The 2000 National Climate Change Strategy contained a number of measures that could have helped constrain Ireland's greenhouse gas emissions but its most important component, the carbon tax, as well as specific measures like the conversion of the Moneypoint coal-fired electricity generating plant to natural-gas firing, were not implemented.[5] In the meantime, major infrastructure programmes have been implemented without full consideration of their likely impact on emissions. For example, a network of motorways has been built to stimulate economic growth, but the lack of warranted investment in public transport and the absence of controls on urban sprawl have allowed these investments to drive up transport-related emissions (Morgenroth and Fitz Gerald, 2006). These are long-term investments whose true value for money might have been lower if the cost of their associated carbon emissions had been taken into account at the time of their appraisal. These investments are likely to lock transport in to its current pattern for decades or longer.

The manner in which policy is developed in Ireland helps to explain the historical failure to grapple with the challenge of climate change. Much national policy in Ireland is developed through consultative processes, particularly through the Social Partnership, a forum where representatives of government, employers, trade unions, farming interests and other sectors negotiate wage agreements and other policy directions. The Social Partnership has been successful in aligning Ireland's economic and social policies while improving competitiveness and avoiding inflation and has been credited with leading the country out of the political, economic and social crises of the 1980s (O'Donnell, 1998, p. 11). But until recently the Social Partnership paid scant attention to climate change and it has excluded environmental groups from the parties represented in the

[5] Moneypoint was extensively refurbished to install sulphur scrubbers instead.

negotiations.[6] The absence of this subject from the primary forum for policy agenda-setting may have relegated climate change to a subject of secondary importance. At the same time radical policy change in Ireland has been hostage to important sectoral interests. The failure of the government to introduce a carbon tax in 2004 was partly due to active lobbying by business groups and opposition from within the government itself: the then-minister for finance, Charlie McCreevy, said that the tax would bring minimal emission reductions at a high bureaucratic cost. In this he was supported by some trade unions, who said that a carbon tax would have a disproportionate effect on the poor. Although these claims were disputed at the time (by, among others, the then chairman of Sustainable Energy Ireland and by research from the Economic and Social Research Institute, which showed that the potentially regressive effect of a carbon tax could be offset by directing some of the revenues to social welfare), the lack of a champion from within the policymaking system undermined the case for the carbon tax.[7] Another feature is the idiosyncratic electoral system in Ireland in which all politicians, including ministers, are elected by proportional representation in multi-seat constituencies, making them particularly sensitive to sectional issues at the occasional expense of national priorities.

But such systemic explanations only go so far to explain why Ireland is not engaging in optimal policies to meet its national greenhouse gas emission commitments. Indeed, the successful national response via the Social Partnership to the economic and social crises of the 1980s suggests that with the same kind of understanding, political leadership and cross-sector participation, reducing greenhouse gas emissions could be attainable. It may also be helpful for policymakers that Ireland is bound by international climate-change commitments. In 2004, opponents of the carbon tax could plausibly argue that the Kyoto Protocol might fail; today, in contrast, "no action" is not a possible response to the challenge of climate change given that Ireland is obliged under EU and UN commitments to reduce its emissions or pay for equivalent emission permits on the international market, a potentially large capital outflow that could pose political difficulties of its own. The commitment in the 2007 Programme for Government that environmental interests will be represented in the Social Partnership as well as the strengthened capacity of Comhar – Sustainable Development Council (a multi-stakeholder forum that provides advice to government on environmental and other issues) could help to articulate the case for long-term climate action.

6 The current agreement, *Towards 2016*, has a specific chapter on "environmental sustainability" (Government of Ireland, 2006). The previous agreement, *Partnership 2000*, contained a few references to the environment, mainly in the context of agriculture. The concept of sustainable development appeared prominently in the 2006 strategy of the National Economic and Social Council, *Strategy 2006: People, Productivity and Purpose*.

7 "Government 'underestimated' effect of abandoned carbon tax", *The Irish Times*, 29 November 2004; Scott and Eakins (2004).

3.1 Underlying Principles for the Next Phase of Irish Climate Policy

The next phase of Ireland's response to climate change is currently being developed. The background to this response is an increased certainty about the urgency of climate change and the likelihood of new international cooperation within the framework of the UNFCCC, propelled by a newly engaged United States. At the same time there is the strong possibility of a widespread and prolonged economic depression following the international financial crises of 2008. Ireland's response should therefore be circumspect and should be based on the following basic principles:

1. **Minimised cost of abatement**: Science informs long-term targets. R&D, demonstration and analysis inform abatement options and cost. The marginal abatement cost curve (the MAC curve) underlies the cost to the economy of reducing its emissions. Given a quantity target, the MAC curve enables one to read off the permit price that would encourage abatement to occur up to the target level: abatement is encouraged because it would be cheaper than paying the permit price. Alternatively, given a price, one could read off the quantity of abatement that polluters would find worthwhile in order to avoid paying the permit price.[8] Governments are not and cannot be omniscient about technologies or individual circumstances, and usually the bodies directly engaged are in a better position than governments to determine their best reduction methods and their timing.

   Picking technologies can have disappointing outcomes for governments, as seen in their promotion of bio-fuels (Ryan *et al.,* 2006). In some cases this involves supporting favoured technologies, such as electric cars, to the relative neglect of strategies on spatial settlement or public transport, for example. Side effects can also be harmful, as seen in Germany's over-generous subsidies to solar panels – the increase in demand for silicon to manufacture photovoltaic cells temporarily drove up the price of silicon and impeded adoption of solar panels in more suitable sunny countries.[9] It is also wasteful to have multiple and rigid targets as these can unwittingly impose high abatement costs. It is better to facilitate flexibility by ensuring a framework that provides the overall incentive to reduce emissions.

   Examples of marginal abatement cost curves reproduced from the recent report of the UK Committee on Climate Change are presented below in Figure 2 (Committee on Climate Change, 2008). The upper graph refers to the UK transport sector and the lower graph to the residential sector. The horizontal axis measures emissions reductions. Going from left to right are the possible ways of reducing emissions in increasing order of cost. Measured on the vertical axis is the cost of reducing emissions per tonne of CO_2. It is seen that some reductions

[8] The same schedule of abatement costs underlies a regime of permit trading or of carbon taxes. The price of permits that results from trading reflects the participants' (true or perceived) marginal abatement costs at that time, subject to the fixed quantity.

[9] "More light than heat", *The Economist*, 7 April 2008. http://www.economist.com/world/international/displaystory.cfm?story_id=10989479

> can be achieved at zero or even negative cost.[10] Other UK sectors covered in the report include industry, power, waste and so forth and the estimates relate to realistic potential technologies. Technical improvements would cause the curves, or sections of them, to be revised downwards, because they make it cheaper to reduce emissions. (The role of research and development to encourage this is discussed below.)
>
> The marginal abatement costs can be aggregated over all sectors to give national costs of reduction. As stated, checking the target level of reductions, or cap, against the national curve enables one to read off the cost of the last unit abated.[11] This marginal cost is the price or tax that would encourage achievement of the target, because all the abatement actions to the left would be cheaper than the tax. A target reduction that is larger (further to the right) is seen from the figure to cost more, as higher cost abatements have to be adopted. The MAC curve underpins emissions mitigation regardless of policy measure adopted. Naturally there are many uncertainties. Side benefits, for example, could extend the scope of reductions by increasing the uptake of technologies, and costs could be driven down in unexpected ways. On the other hand there could also be behavioural barriers. A key point is not just the variation in abatement costs seen here, but the variation that applies across different individual entities in different circumstances.

Over sixty estimates of the world MAC have been made by various researchers based on least-cost trajectories of global efforts to meet stabilisation targets. Kuik *et al.* (2009) have recently assessed these estimates as a group. The estimates are based on numerous assumptions as to the stabilisation target and baseline, the extent of flexibility in the path of reductions over the time period and on whether or not all greenhouse gases are included, and so forth. As expected, it is found that the more stringent the target the higher the abatement cost, while flexibility with respect to timing of reductions and inclusion of all greenhouse gases (rather than merely CO_2) reduces the cost. Kuik *et al.*, then extend this exercise to derive a kind of consensus global cost of carbon that would be needed to achieve a range of reduction targets expressed in terms of CO_2 concentrations in parts per million by volume (ppm). To achieve the long-term target of 450 ppm of CO_2 equivalent, which is more or less consistent with the EU's 2ºC warming target,[12] the central CO_2 price in 2025 could be some €129 per

[10] Inclusion of the cost of time to find and absorb information about such actions and the associated hassle could reduce the amount of scope at negative cost, however.

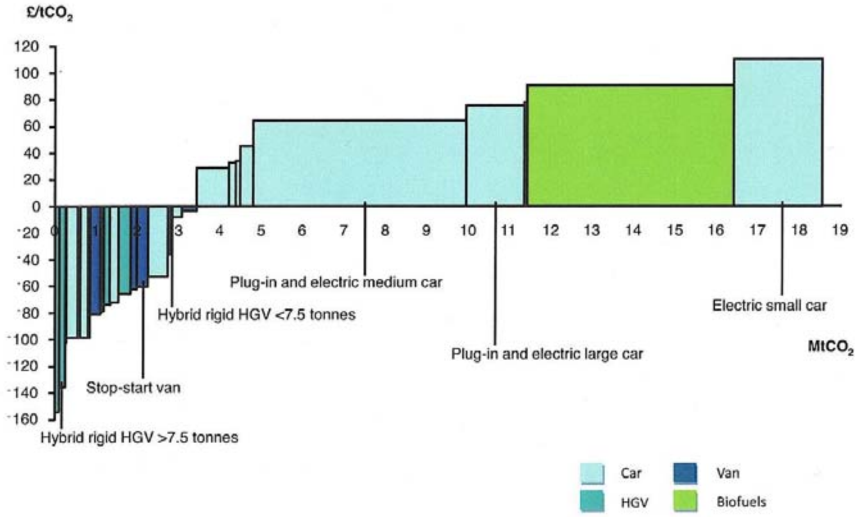
[11] The marginal abatement cost is distinct from the marginal damage cost. The latter, sometimes referred to as the social cost of carbon, is a measure of the damage done by an extra tonne of CO_2 emitted. This is the damage of climate change, which is highly uncertain, and by contrast it declines as pollution is reduced. Checking it against the estimated marginal abatement cost curve would give the theoretical optimum reduction and price. Appraisals in the public sector in the UK are required to employ a social cost of carbon (DEFRA, 2008).

[12] This approximate temperature rise of 2°C is the IPCC's Class 1 of scenarios, which corresponds to 350-400 ppm of CO_2 or 445-490 ppm of CO_2-equivalent (Nakicenovic *et al.*, 2007).

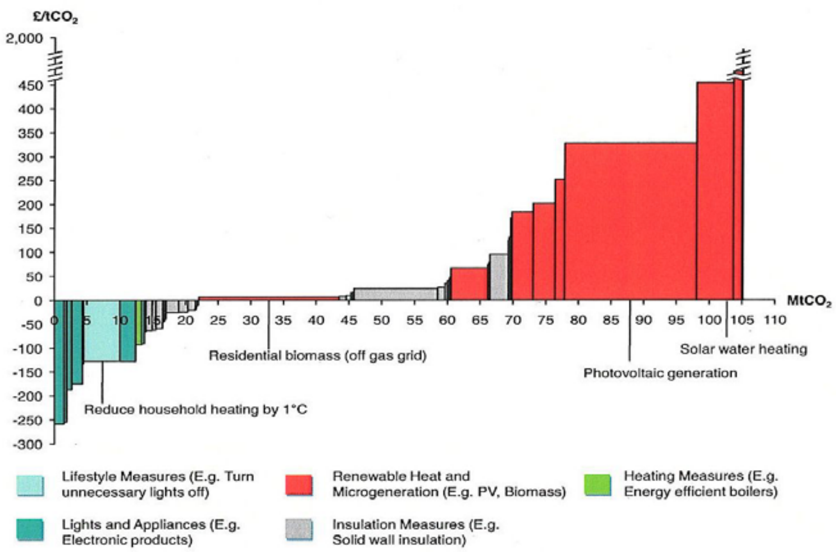
tonne but with a wide range of uncertainty from €69 to €241 per tonne. In 2050 the price could be €225 per tonne, with a range from €128 to €396 per tonne.

Figure 2: Cost and Technical Potentials for Reducing CO2 Emissions in the UK

Road Transport in UK – MAC Curve



Residential Sector in UK – MAC Curve



Source: Committee on Climate Change, 2008, Figures 6.11 and 7.15.

2. **Equal emissions price**: Charging everybody the same emissions price per unit of CO_2e promotes cheapest abatement. Some abatement is expensive and should be given less priority. For example, some (not all) transport abatement is very expensive. One needs to consider the net costs of reducing emissions, which can be high if the benefits of transport are high. An equal emissions price has the benefit of not encouraging high-cost abatement at the expense of missing out on (possibly unknown and even unknowable) low-cost possibilities. People who have only high-cost options would pay what is to them the

relatively cheaper carbon price instead. Therefore, an equal price needs to attach to all carbon emissions, otherwise the cost of action will increase significantly. Every emission causes damage and imposes a non-zero cost. This "social cost of carbon", though only possible to estimate very approximately and within a wide range, would ideally be the set price.[13] All should face the cost of emitting otherwise some cheap options may be omitted, raising the cost to society as a whole of achieving its reductions. Such flexibility should not be confined to be within one's borders. The cheapest abatement projects need to be taken on regardless of where they are, given that funds are not limitless.

3. **Minimal negative macroeconomic effect**: The levels of reduction under consideration for the long term are so large that the issue has to be viewed as a macroeconomic one. Subsidies to encourage emissions reductions would have to be financed from taxes and taxes have a deadweight effect on the economy. Pollution taxes, such as carbon levies, too can deflate the economy, but revenues from pollution taxes can be used to replace other undesirable taxes and in this way potential macroeconomic harm is restrained and may even be overcome. Thus "compensating the economy" should not be overlooked. Meanwhile, technological developments that are encouraged by pollution taxes could be a great boon in reducing the cost of reducing emissions (reduce the MAC curve). Given that invention and demonstration provide public benefits not captured by the originator, these activities are unlikely to be undertaken to their ideal level without government support.

In sum, keeping down the cost of reducing emissions has to be a major concern. The targets are very demanding and risk being expensive to achieve, in macroeconomic terms even. The objective should be to enable the people with best knowledge to choose how to change their ways, subject to real incentives and without imposing excess net taxation on the economy.

[13] As described, the "social cost of carbon" is the marginal damage caused by an additional tonne of emissions. The range, which is obviously wide, is very sensitive to the assumptions underlying the estimations. The optimal price of carbon is that which equates with the marginal abatement cost. For estimates of the social cost of carbon, see Tol (2009).

4. A SURVEY OF CLIMATE POLICY OPTIONS AVAILABLE TO IRELAND

Reduction of greenhouse gas emissions in absolute terms should be the overarching priority for climate policy in Ireland. Although Ireland's total contribution to international greenhouse gas emissions is miniscule, the country could make a worthwhile contribution as a demonstration that intelligent policy reform can lead to reduced absolute emissions while generating other social and economic benefits.[14] But an aggressive approach to climate policy in Ireland will be controversial to many economic actors, particularly at a time of international financial crisis, because climate policy is often associated with additional costs to industry. Nevertheless, although reducing emissions raises legitimate questions about costs, with appropriate policies there need be no impact on competitiveness for the economy as a whole. Even though there may be real impacts on limited specific sectors, these sectors (or even individual companies) could negotiate a targeted policy approach and need not become a brake on national policy. The cost consideration properly evaluated may weigh in favour of promoting some domestic emissions reduction over international trading. The National Climate Change Strategy 2007-2012 foresaw an outlay of €270 million to purchase emissions credits on the international market, which assumes a permit price of about €15 a tonne of CO_2e (DEHLG, 2007, pp.17-18); the price of carbon on the EU ETS, currently about €13 (July 2009), is volatile but projected to rise by 2020 and beyond.[15] Depending then on the relative cost of abatement at home, relying on international trading could represent a saving or a growing burden on the national economy. On the other hand, implementing cost-effective emissions reductions is in itself a sound investment in the future. If Ireland fails to take cost-effective action early in the process it could be faced with an increasingly expensive task of reducing its emissions later, or purchasing ever larger amounts of emission

[14] It is noteworthy that the plastic bag levy (introduced in 2002) has become an international icon in environmental policy. Ireland also has little tradition in the type of science and engineering that reduces greenhouse emissions but that need not deter formulation of sound policy in relevant areas.
[15] Point Carbon, http://www.pointcarbon.com

permits.[16] The potential costs of inaction to society as a whole must therefore be considered alongside the costs of action.

At the same time, adaptation to climate change presents opportunities as well as challenges. Climate change policy (whether involving mitigation or adaptation) is likely to be disruptive for some sectors, but this does not mean that its overall impact will be negative in the long term. Indeed, successive European Commission studies have found that tackling climate change could have (limited) positive impacts on economic growth and employment across the European Union provided that appropriate policies are in place, with some important shifts in employment patterns between sectors (ETUC 2007, p. 182). Businesses that have low energy requirements or deal with the technologies that are suited to a low-carbon economy will prosper in a carbon-constrained economy, and Ireland could benefit by being among the first movers in this significant area of future economic development.

The various policy approaches to address climate change can be divided somewhat arbitrarily into several broad categories. The rest of this section is a discussion of the pros and cons of the following approaches:

- Legislative.
- Market- and incentive-based.
- Standards & regulations.
- Subsidies.
- Research & development.

4.1 Legislative Instruments

Irish policymakers must now operate under the assumption that reducing emissions is an unavoidable priority. The first objective of climate policy in Ireland should, therefore, be to create the necessary political certainty for all economic actors that Ireland will be bound by a real carbon constraint. One way to provide this certainty would be to enact a legally binding long-term target, as several jurisdictions have already done. California passed a bill in 2006 requiring a reduction in CO_2 emissions by 80 per cent by 2050, and the UK parliament adopted a similar measure requiring reductions of CO_2 emissions by 60 per cent by 2050. Reducing Ireland's emissions by 2050 to about 11 $MtCO_2e$ would equal an approximate 80 per cent reduction below Ireland's 1990 levels, a pro-rata contribution to the overall EU target of reducing emissions by 60-80 per cent by 2050. Friends of the Earth Ireland proposed a Climate Bill that would oblige the government to effect annual reductions in Ireland's greenhouse gas emissions of 3 per cent (FoEI, 2007) to lead to reductions of 60 per cent below 1990 levels by 2050; an 80 per cent target (to about 10 $MtCO_2e$) would require average annual cuts of 4 per cent.[17]

An advantage of such a legislative approach is that it presents an additional degree of certainty for government departments, private businesses and other stakeholders under which to plan future operations.

[16] The effects of climate change may also be increasingly felt in Ireland, e.g. water services costs.

[17] See Annex 1 for calculations.

Furthermore, politicians would be discouraged from postponing some politically difficult decisions until after the next election cycle. A system of interim (e.g. annual, five-yearly) targets could be strengthened by a transparent facility for "borrowing" from future targets, with appropriate interest, or "banking" better-than-expected reductions to encourage over-compliance. The drawback of a legislative approach is that the penalties for non-compliance could be difficult to define or enforce. Targets have to be informed by the estimated costs to which a country is committing itself and abatement costs for large reductions in emissions are likely to be high, although possibly tempered by technological developments that may have occurred in the meantime. To be credible the negotiating stance of interested sectors needs to be backed up by independent research. Costs in any event are uncertain and at the same time the nature of the climate problem can alter so this too has to be taken into consideration. Inevitably such targets are aspirational. To ensure political certainty therefore, a long-term national target could be set and made to define national actions, although this target does not need to have the force of law.

4.1.1 CLIMATE CHANGE COMMISSION

In any case, a target on its own is not a policy. Accompanying measures such as an annual carbon budget[18] and strategy review will be necessary to drive action and, crucially, policy coherence across different government departments and agencies. The proposed Climate Change Commission foreseen in the National Climate Change Strategy could play an important role. The commission would be a new body with the authority to "…monitor and assess Ireland's progress in addressing climate change and to increase awareness in all sectors of the opportunities and challenges presented by the transition to a low-carbon economy" (DEHLG, 2007, p. 48). An appropriately resourced commission with the necessary mandate and independence could play two useful roles. First, it should undertake a continuous review of Ireland's climate performance, throwing light on costs of emissions abatement and effectiveness of policies and measures and possible improvements. Second, it could play a role in effecting an open and iterative process of policy coordination, including public participation and submission and at least partially insulated from political interference. This is necessary to generate the level of debate and public trust that will be required to bring about the necessary changes, some of which could be disruptive to individual sectors of social groups. As part of its investigation of abatement costs, the commission could help identify the contributions that individual parts of the economy could play and act as a clearing house for information to help different actors contribute. No less importantly, it could act as a non-partisan source of political pressure to help the public determine whether specific policies proposed by any government department or authority are consistent with the national priority of reducing Ireland's greenhouse gas emissions in a cost-effective and socially just way. Any such commission would need to complement and not duplicate the work of existing bodies working on climate change (e.g. the Environmental Protection Agency, Comhar – Sustainable

[18] The Programme for Government instituted a carbon budget (p. 19) as a reporting mechanism. This is in contrast to the approach outlined in a report by ECOFYS/Friends of the Earth United Kingdom, which suggests that the carbon budget could act as an instrument for allocating rights to scarce allowances permitted under a legally binding national cap (Gilbert and Reece, 2006, p. 15).

Development Council and Sustainable Energy Ireland). This could be done by including its functions in one of these bodies or providing it with a limited but robust mandate that would allow it to compel these other bodies to provide it with the necessary information and administrative support.

4.1.2 THE USE OF THE INTERNATIONAL FLEXIBLE MECHANISMS IN REACHING THE NATIONAL TARGET

An important question to resolve at the outset is the extent to which Ireland should reduce its greenhouse gas emissions through domestic policies and measures as opposed to relying on reductions made abroad, through the international carbon market. The Kyoto Protocol allows countries to trade their emission allocations and also permits the use of two project mechanisms – Joint Implementation (JI), which entails projects undertaken jointly by industrialised countries, and the Clean Development Mechanism (CDM), consisting of projects funded by developed countries but executed in developing countries. Ireland has already decided to purchase up to €270 million worth of credits from abroad for the period 2008-2012 if necessary. The EU Emissions Trading Scheme also allows entities to purchase a limited amount of credits from the project mechanisms.

In theory, international emission trading provides a flexible way for countries or companies to meet their emission targets by allowing them to use lower-cost credits from a project that occurs elsewhere. The advantage of the project mechanisms is that they can reduce abatement costs by providing firms with additional choice and flexibility in reducing emissions. Developing countries stand to benefit from the transfer of technology that accompanies some projects. In practice, however, these mechanisms face practical difficulties in implementation that distance them from the theoretical ideal to something closer to nominal compliance. Many projects do not cause the abatement of any "additional" carbon emissions – they simply award credits to projects that would have happened anyway,[19] and there are reports of artificial increases in emissions (Wara, 2007). In the case of the CDM the majority of project funding goes to just a few countries (e.g. China and India) and most projects are large, e.g. the elimination of industrial greenhouse gases. Another key difficulty is that the carbon benefits of some projects, particularly from afforestation and reforestation, are difficult to measure and may not be permanent (the forests may be cut down in the future). This is why the European Union has excluded credits from forestry, land use and land-use change from the EU Emissions Trading Scheme.

A critical issue is the absence of carbon pricing for over two-thirds of Irish emissions, as the non-ETS emissions are not subject to a carbon tax. Therefore, while people gain credits by investing in abatement abroad, home owners investing in domestic efficiency measures, for example, do not gain from carbon savings relative to their neighbours who do not invest. Furthermore, the neighbour can free-ride on the investor's

[19] "Beware the carbon offsetting cowboys", *Financial Times*, 26 April 2007. This is not to mention the transactions costs including commissions and the creation of a new layer of market functionaries.

contribution to the national effort. We saw the sort of unexploited opportunities that exist in the domestic MAC curve, above, and this is an example of the distortions resulting from failure to impose one price to all for carbon.

Flexible mechanisms have a role but we note the arguments for circumscribing their use. Since lower-cost abatement opportunities may exist abroad, restricting mitigation to domestic action could raise costs to controlled sectors. But extensive recourse to international trading may not be optimal for society as a whole because money spent on credits from abroad is lost to Ireland, as are any secondary benefits that would have accrued from emission reductions at home (e.g. reduced air pollution generally from reduced consumption of fossil fuels). As explained, there are lower-cost abatement opportunities in Ireland that current policies do not bring about. The principle of "supplementarity", i.e. a preference for domestic abatement over the international flexible mechanisms, is enshrined in the Kyoto Protocol;[20] it is also reiterated in the EU Directives governing the EU Emissions Trading Scheme, which set out limits on the extent to which credits from the Kyoto Protocol's flexible mechanisms can be used in the scheme.[21] Although restricting abatement to domestic measures robs third world countries of the benefits of project mechanisms, e.g. technology transfer, a more considered use of the project mechanisms could help resolve these issues.[22] Discriminating in favour of best-practice projects using correct prices can help ensure that the benefits of investment and technology transfer are shared among more developing countries and a range of socially beneficial project types.

The transfer of technology to developing countries is vital. Some technologies, such as those that enhance energy efficiency, may diffuse in the absence of a targeted policy through the ordinary globalisation process of international trade and foreign investments. However, the diffusion of specifically climate friendly technologies and the actions of multinationals need investigation through research (Popp, 2002). In particular encouragement to promoting knowledge spillovers may need extra support from developed countries.

[20] Article 6.1 (d): "The acquisition of emission reduction units [from project mechanisms] shall be supplemental to domestic actions"; Article 17: "Any such trading shall be supplemental to domestic actions for the purpose of meeting quantified emission limitation and reduction commitments". There is no current legal definition or guidance to what "supplemental" means in practice, but the possibilities for worthwhile abatement in Ireland suggest that a sizeable effort should be through domestic policies and measures.
[21] "The plan shall specify the maximum amount of CERs and ERUs which may be used by operators in the Community scheme as a percentage of the allocation of the allowances to each installation. The percentage shall be consistent with the Member State's supplementarity obligations under the Kyoto Protocol and decisions adopted pursuant to the UNFCCC or the Kyoto Protocol." Directive 2004/101/EC amending Directive 2003/87/EC, quoted in Grian (2005).
[22] The potential benefit of flexibility is well established and applies broadly. For example, within the EU, a first best solution is shown to be a single market for all emissions, that is, between agents that are in or outside the EU ETS and between member states, rather than to have targets for each of these entities (Tol, 2008).

Another potential source of international carbon credits may become available in the form of credits from avoided deforestation in tropical countries. (This is distinct from afforestation and reforestation.) The UNFCCC negotiations are expected to lead to the adoption of a new mechanism, Reduced Emissions from Deforestation and Forest Degradation (REDD), by which developed countries will compensate developing countries for not clearing their forests (and, therefore, foregoing the financial benefits that they would have gained from exploiting their forests). The mechanism could play a significant role in the global climate regime, given that approximately 20 per cent of current annual global emissions come from deforestation. Ireland, like other developed countries, is likely to benefit from this mechanism, but it should be cognisant of potential negative consequences of a mechanism that protects forest carbon at the expense of biodiversity or local communities that currently rely on the forests (the details of the mechanism have not been settled, so such negative outcomes may not materialise). Current effort should be directed to promoting the best possible design of the REDD mechanism from a broad perspective of sustainable development. In line with Ireland's priorities in official development assistance, once the mechanism is in place Ireland should seek to discriminate in favour of good-quality REDD projects, as with the other flexible mechanisms.

Given the amount of credits (some of dubious quality) that may be available on the international market, a country could be in technical compliance with an international commitment without reducing any of its own emissions nor, in practice, contributing to any global reduction. To rectify this, the government could indicate the manner to which it intends to rely on the Kyoto Protocol's (or any successor treaty) flexible mechanisms, as opposed to reducing emissions through domestic policies and measures. The government could set conditions for determining the level of reliance on foreign abatement measures. Properly explicit costs of domestic alternatives would determine the correct use of the flexible mechanisms. The government ought to be satisfied that projects under flexible mechanisms will be evaluated and ensure that minimum criteria on sustainable practices are met. This position needs continuous vigilance internationally to encourage countries to drive the market for good-quality investment projects.

The issues causing concern are:

1. Additionality: Does the GHG emissions reduction achieved by a project constitute additional reductions, i.e. new reductions that would not have occurred without the investment?

2. What is the baseline against which to measure this? The baseline has to be estimated as it refers to what a facility's GHG emissions would have been without the investment.

This concern has led to an elaborate set of safeguards (Larson *et al.,* 2008; Lecocq and Ambrosi, 2007). Guidelines have been drawn up by the

UNFCCC.[23] Most aspects with respect to the CDM fall under the supervision of host national regulatory agencies and the methodologies must be approved on behalf of the UNFCCC by an international supervisory group, the CDM Executive Board, with provision for checks to be carried out by an independent firm or organisation that has been accredited to the Board. The type of project is another controversial issue, where industrial plants present the introduction of more efficient fossil-fuel based technologies as projects. In the end these may not deliver significant reductions in emissions. For the CDM to operate effectively, procedures in place have to overcome the challenge posed by the fact that there are incentives for both investor and host country to exaggerate the environmental benefits of the project.

4.1.3 DOMESTIC PROJECTS

Another way of approaching the use of projects to offset emissions elsewhere is to look at projects that take place at home. A voluntary offset scheme could provide a worthwhile means for government departments and agencies as well as individuals to reduce their nominal carbon emissions. The provision in the Programme for Government to offset all official air travel (Government of Ireland 2007b, p. 20) is welcome if it encourages alternatives to travel, rather than merely raises government costs, though such encouragement could be minor given that the officials concerned do not pay. The beneficiaries in voluntary offset schemes should be expanded to include other kinds of projects beyond "urban forests" (as proposed in the Programme) and should not be restricted to Ireland. Funding domestic projects is potentially a better use of public money than purchasing international credits where they are not properly linked to verifiable emission reductions.

Even in lieu of any formal domestic project mechanism, however, the public sector can play a large role. The government is one of the State's largest economic actors. It is the State's largest single landlord and tenant through its occupation of public buildings and its provision of social housing. It maintains a large fleet and has control over many of the State's public transport providers. It has bulk purchasing power. More than many private-sector actors, it has the ability to base economic decisions on a timeframe of 20 years and longer. In these and other areas the public sector should be stating its emissions, attaching a price to them and adopting highest standards, consistent with value for money.

[23] Approved baseline and monitoring methodologies are given in http://cdm.unfccc.int/methodologies/index.html; for accreditation of certifiers as detailed in Annex 2 to the report of the CDM Executive Board's meeting of March 2009 see http://cdm.unfccc.int/EB/046/eb46_repan02.pdf, and for the introduction of random spot checks (version 9) rather than scheduled inspection of verifiers (designated Operational Entities or DOEs) see Annex 3 http://cdm.unfccc.int/EB/046/eb46_repan03.pdf.

4.2 Market- and Incentive-based Instruments

Market- and incentive-based instruments – particularly fiscal measures and emissions trading systems – are intended to put a price on emitting carbon. Market-based instruments are particularly appropriate for addressing climate change.[24] This is because of the varying potential and range of costs of reducing greenhouse gas emissions, the incentives that such instruments can offer individual actors to reduce emissions, and the benefit of dynamic efficiency due to the continuous incentive for the adoption of better abatement technologies. As they put a price on emissions they have the special advantage of addressing the underlying problem, which is that harmful actions are not charged for.

But as mentioned, a price currently only applies to about 30 per cent of Irish carbon emissions, that is, to the sectors that participate in the EU ETS. As already outlined, if the price is not charged to all emitters, including small enterprises and households, opportunities to reduce carbon emissions will be missed. Without a carbon price, energy-saving measures that would have good present values (or paybacks) at that price risk only being undertaken by the dedicated. The consequence would be that more effort has to be applied in other areas, areas that may be more expensive (European Commission, 2007a). A priority for the government is therefore to establish a price on all carbon to make energy/carbon-intensive activities more expensive relative to other activities. This is most efficiently achieved through a domestic carbon tax, as described below. Other fiscal instruments under the heading include emissions trading and user pricing, especially for road transport.

4.2.1 CARBON TAXES

The all-important aspect of a carbon tax is that it can set a long-term credible price on emitting carbon. This would provide incentives for would-be investors in technical advances and for consumers to switch to more energy-efficient heating systems or implement energy-saving measures, such as improved insulation. A carbon tax was announced in the 2007 Programme for Government but has not yet been introduced (as of June 2009). Ireland has had good experience with fiscal-type measures. In recent years there has been the introduction of payment-by-weight for rubbish, which resulted in a reduction of over 30 per cent in one instance studied, despite the low price elasticity of demand of -0.27; the introduction of metered water charges by group water schemes with up to 40 per cent reduction in water use; and the introduction of the plastic bag levy, which has reduced consumption of plastic bags by over 80 per cent.[25] These

[24] The OECD (2008) has simulated stabilising greenhouse gas emissions at 450 ppm CO_2 equivalent over the longer term and found the costs of action to be 0.5 per cent of GDP by 2030 and 2.5 per cent by 2050. The policy scenario assumed the introduction of a globally-harmonised carbon tax, which is pre-announced so that investors take rational decisions. If OECD countries alone implement a carbon tax starting at $25/tonne of CO_2 in 2008, this would lead to a 43 per cent reduction in OECD greenhouse gas emissions. However, global emissions would still be 38 per cent higher in 2050 compared to the 2000 levels. If Brazil, China, India and Russia follow suit with the same policy in 2020, and the rest of the world in 2030, global greenhouse gas emissions in 2050 could be brought down to the 2000 levels (0 per cent increase).

[25] The fact is often overlooked that a carbon tax would help policies on recycling (Barrett and Lawlor, 1995).

measures have been especially well-suited to their situations and involved a stiff price rise. A carbon tax set at a rate of, say, €20 per tonne of CO_{2e} may have a minor initial effect on emissions, but its impact would lie in its long-run certainty. See Annex 2 for examples of different rates of carbon tax applied to the main fuels used.

Carbon taxation, applied as a tax on fuels, can correct the market failure arising in energy use by simply charging emitters for the damage done by CO_2 emitted by combustion. Carbon taxation is a more effective instrument for reducing energy-sector CO_2 emissions than other kinds of taxation on energy *per se* because it discriminates fairly between energy sources according to their greenhouse gas content (Stavins, 1997, p. 9). The abatement achieved by carbon taxes and the effect of the tax on the economy depend on several factors, including the point of application of the tax and what is done with the revenue. Studies undertaken in the Economic and Social Research Institute and elsewhere since 1992, shortly after the European Commission[26] had proposed such an approach, have consistently shown that their macroeconomic impact depends on the use to which the revenues are put, after low-income households have been helped (Fitz Gerald and McCoy, 1992; Fitz Gerald *et al.,* 2002; Bergin *et al.,* 2004; Conefrey *et al.,* 2008; Scott and Eakins, 2004; Callan *et al.,* 2009). Carbon taxation's impact can be depressing or mildly favourable. The favourable result occurs specifically in the case where the bulk of the revenue from a carbon tax is recycled to help the economy, through a reduction in taxes on labour (e.g. income tax or social insurance contributions). The importance of this finding is that it illustrates the fact that climate change policies could undermine the economy unless, by reducing labour costs, they address the potential setback to Ireland's competitiveness. Subsequent work has had to allow for the fact that the range of application of carbon taxes was reduced when the sectors with large emitters joined the EU ETS (see below). But as both measures are basically a means of pricing emissions, the logical approach is to relate the two prices by, for example, setting the carbon tax annually at the permits futures price, suitably constrained to impart stability.

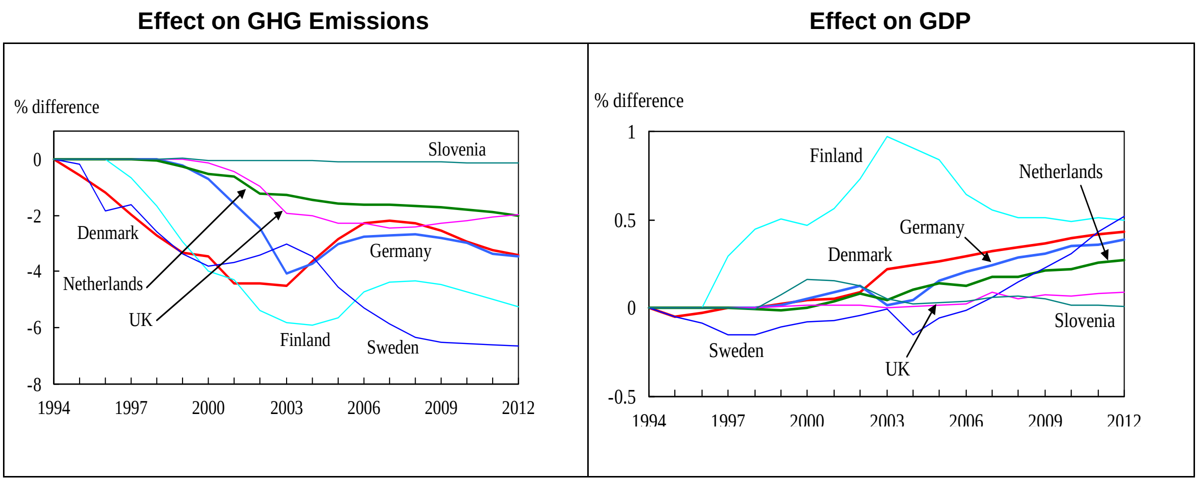
Using the revenues to subsidise energy efficiency projects meets with popular approval, but needs to avoid the problems associated with subsidies, as discussed below. In particular, the cost per tonne abated through the subsidy route needs to be explicit. The UK government requires electricity suppliers to direct the foregone revenues (these are the suppliers' windfall gains due to the EU emissions trading scheme) to such energy saving projects. But this has the added difficulty of incompatible incentives. The utility has a long term interest in increasing energy sales, not decreasing them. Using gains to reduce energy prices, thereby reducing the carbon price, similarly runs counter to policy objectives.

The evidence from other European countries shows that environmental taxation, of which carbon taxation is one example, can have a positive impact on economic growth and competitiveness (Andersen and Ekins, 2009). The COMETR research project (*Competitiveness Effects of Environmental Tax Reforms*), funded by the European Commission, found that the introduction of carbon or energy taxes with revenue recycling in Denmark,

[26] Delbeke (1991).

Germany, Netherlands, Sweden and Finland had a positive effect on GDP compared with the counterfactual reference case of no environmental tax reform (European Commission, 2007b).[27] The effect was neutral in the case of the United Kingdom (see Figure 3). These results are all the more significant, given that the introduction of carbon taxes in these six countries was at a very modest level and far from co-ordinated. As the European Commission points out, competitiveness is not only an economic concern but also an environmental one, because the migration of polluting industries to countries with lower standards would not reduce global emissions. The COMETR research project found that in the six EU Member States that have carried out green tax reforms, "carbon leakage"[28] has been very small and in some cases negative (Barker *et al.,* forthcoming). In so far as Ireland's economic competitors in the European Union also introduce such fiscal measures, this would further diminish any harmful effects that a domestic carbon tax might have on Ireland's competitiveness, given that most of Ireland's trading competitors are based within the European Union.

Figure 3: The Effect of Environmental Tax Reform



Source: COMETR (2007); Barker *et al.* (2009).

An important issue is the effect of carbon taxes on low-income households and vulnerable sectors. Carbon taxation would indeed have more adverse impacts on individuals and sectors that consume above-average amounts of energy or are very dependent on solid fuels, the most harmful sectors. According to the COMETR project, the sectors most vulnerable to a carbon tax would be basic metals and paper and pulp industries, whereas cement would be relatively unaffected. Such results help to show where special consideration is required. But one of the points of such a tax is to provide a long-term signal that could encourage people, where possible, to choose less carbon-intensive lifestyles and investments. Moreover, the revenues collected can be recycled to help households that are disproportionately affected by the increase in fuel prices. This only

[27] Slovenia was included in this study, though the country only implemented environmental tax reform in a limited way.

[28] Carbon leakage is the displacement of the emitting industry from one geographical area to one with lax policy, dubbed a "pollution haven", with no resulting reduction in global emissions. It can be a manifestation of competitiveness loss.

requires a modest share of the revenues to be set aside for this purpose (Scott and Eakins 2004, p. 13; Callan *et al.,* 2009).

Another perceived disadvantage of carbon taxation is that some sectors – particularly transport – are relatively insensitive to price rises due to low elasticity of demand, especially if there are few alternatives to present modes of operating, leading to potentially increased costs and little reduction in emissions. Nevertheless, a predictable price signal is likely to have an effect on energy demand in such sectors as seen recently in the United States, and more so in the long term. The US Congressional Budget Office (2008) reported that gasoline price rises in 2008 resulted in responses "…large enough to interrupt a pattern of steady growth in gasoline consumption dating back to 1990, the last time US gasoline prices rose substantially". During 2003 to 2006 motorists already adjusted their driving habits (making fewer trips and driving more slowly). After increasing steadily for more than 20 years, the market share of light trucks (including SUVs) began to decline in 2004. Persisting high prices are expected to cause inefficient vehicles to be replaced with fuel-efficient ones.

The generation of additional revenue is a pivotal difference between a carbon tax on the one hand and high energy prices caused by external factors (and, as seen, free emissions permits) on the other. Another difference is that higher energy prices due to a rise in the price of crude oil promote development of polluting fuels such as tar sands. The effectiveness of a carbon tax will depend on accompanying measures, especially for activities with high emissions and a low sensitivity to price increases. Regulations, in the form of sound planning rules, parking constraints and investment in public transport are some other recommended measures. Concern that transport would still be "too high" reflects perhaps that other damages are not properly addressed,[29] along the lines suggested in *Efficient Transport for Europe – Policies for Internalisation of External Costs* (ECMT, now the International Transport Forum, 1998).

4.2.2 EMISSIONS TRADING

Emissions trading allows overall emissions from a sector or economy to be reduced by a certain specified amount at minimum cost to the economy. This is because each participating firm can choose to do what is cheapest for it, whether that is to reduce its emissions or purchase additional permits, depending on the price. In a cap-and-trade scheme a cap is set across the economy or economic sector by a regulator. Permits are allocated to participating firms according to a division of the overall cap, and firms are obliged to restrain their emissions to their allocation of permits or else purchase additional permits. In this way the regulator creates a scarcity that in turn creates a carbon price depending on demand and the cost of abatement. There are many design options that will affect the performance and equity of an emissions trading scheme, including the method of allocation (e.g. by auctioning or on the basis of some previous level, called grandparenting), the penalties for non-compliance, the definition of participating entities and the point at which emissions are

[29] Including those due to perverse subsidies. It goes without saying that the objectives of any subsidies awarded to fuels can probably be achieved by other means.

controlled. The EU ETS (discussed below) controls emissions at a mid-point of the economy – large-scale industrial users of energy. An alternative approach would be to control emissions at the point of energy production or importation ("upstream") or at the point of individual energy consumption ("downstream"). An upstream system with auctioned permits works like a carbon tax, in that the price of permits (being valuable "inputs") is passed onto consumers. The difference is that the rate of the "tax" is variable and not automatically predictable as the price varies according to abatement costs and the scarcity of emission permits. Because there are quite few entities to control (refineries, fuel importers), an upstream system is relatively cheap and simple to administer. A downstream system is more complex to administer, with higher transaction costs and more regulated entities.

4.2.3 THE EU EMISSIONS TRADING SCHEME

Ireland participates in EU ETS, which began operating in 2005 and controls emissions mid-stream, that is, from large-scale fixed-source emitters, such as large industrial units and power-generating stations (European Union, 2004). It covers about 45 per cent of EU greenhouse gas emissions (30 per cent of Irish emissions) but omits sectors like transport and agriculture. The current trading scheme runs until 2012 and the broad rules for the post-2012 scheme were decided as part of the EU Climate and Energy Package agreed in December 2008.

A problem (somewhat addressed in the post-2012 phase) is that permits in the EU ETS have been allocated almost entirely by grandparenting, which gives permits to firms for free depending on their historical performance.[30] Granting permits for free instead of requiring firms to buy them on the market was intended as a way of generating the political support for the scheme, but it has led to some perverse outcomes. First, grandparenting can reward firms with poor environmental records, since they are likely still to have low-cost abatement opportunities that other firms may have already exploited (indeed grandparenting may encourage poor environmental standards). This issue can be addressed by benchmarking allocations against an appropriate performance standard that has to be established. Second, allocation for free creates an incentive for firms to lobby for the most generous possible allocation. Over-generous allocation in the EU ETS contributed to considerable volatility in the permit price: the sharp fall in the price of permits (from €29.90 in April 2006 to €12 in May 2006), triggered by the release of data showing a surplus in the market, reflected overly generous allocations by some EU Member States to their polluting industries (Convery and Redmond, 2007). The price was around €24 (September 2008) falling to a price in the region of €10 by February 2009.[31] Such volatility undermines the benefit of the price signal provided by a carbon market. Third, grandparenting creates

[30] During the pilot phase, Member States were allowed to auction up to 5 per cent of their total allowance allocation. Only Ireland, Denmark, Hungary and Lithuania have exercised this option to any extent (Convery and Redmond, 2007). Ireland auctioned 1 per cent of its allocations under the first National Allocation Plan. Despite the apparent success of this exercise, only 0.5 per cent of Ireland's allocations are being auctioned under the second National Allocation Plan (http://ec.europa.eu/environment/climat/pdf/nap_tables_ireland.pdf)

[31] http://www.pointcarbon.com

something close to a free property right that firms will not want to relinquish in the future. This is a right to use of the atmosphere, and it is similar to other such rights. The experience of milk quotas and taxi and liquor licences in Ireland shows how politically difficult it can be to change a system in which government-created scarcity increases the value of permits and thereby provides an incentive to the permit holder to resist socially beneficial change to the permit system. Grandparenting benefits incumbents, to the disadvantage of potential new entrants and even clean technologies. Fourth, freely allocated permits that can be sold, or where their value can be realised through raising prices to consumers, provide an effective subsidy to emitting firms. This is the case in the power generation sector, where firms are able to pass through prices to consumers (Fitz Gerald and Tol, 2007). It may also be a problem in the aviation and maritime transport sectors, if they are granted emission permits for free. For air travel some other instruments could be considered, e.g. an integrated EU air traffic control system (which would reduce emissions), a carbon tax or (ultimately) full auctioning of permits in an emission trading scheme.

4.2.4 COST-CONTAINMENT OPTIONS

In an emissions trading scheme, volatility in the permit price for CO_2 emissions creates uncertainty for producers and complicates their investment decisions. If they feel that there is a risk that prices will fall, they will fear that their investment in clean technology could become unviable. They may feel inclined to invest more effort investigating a deal on fuel price than on potential abatement technologies.[32] We saw that, for a given number of permits available, the market price in the EU ETS at any particular time reflects the carbon abatement cost. Fluctuations are to be expected depending on the changing circumstances of many agents. A case has been made by Helm for containing the price variation by imposing a floor and a ceiling on permits prices (Helm, 2008b). Not just a help to investors and a guard against a public backlash during oil price spikes, such a proposal has an economic rationale. It would enable the price to be tailored towards the social cost of carbon and would stabilise prices. When or if full auctioning of permits replaces grandparenting such stability will be all the more attractive.

A predicable and credible carbon price helps decisions on all sides of the market and particularly decisions on emissions reduction. The price fluctuations have the advantage of being counter-cyclical, but uncertainty and extremes are unhelpful. A floor to the minimum carbon price would increase certainty about the long-term value of investments that reduce emissions (US GAO, 2008a). The likely profile of prices in the medium-term is currently far from clear, when one considers that entry of new countries into emissions trading in the 2012-2020 period could involve some over-generous allocations of permits. An expectation that permit prices will fall discourages abatement including recycling, is especially discouraging to long-lived investments, and volatility in general imposes a real cost. Futures markets can dispel volatility only to a limited extent in a regime that is in any case subject to periodic updates.

[32] As reported by Sorrell *et al.* (2004).

A floor price that bears a relationship to the social cost of carbon could remove such uncertainty, and thereby remove the bouts of price discouragement to research into renewables and low-carbon technologies. A ceiling in its turn would mean that CO_2 intensive industries would feel less incentive to relocate. Furthermore any energy price shocks to the EU, whether induced by external events or internal shortages, that increased reliance on coal with concomitant demand-induced rise in the price of permits, could strain the will to maintain the system. This would especially apply before clean coal technologies in the form of carbon capture and storage became available. The floor and ceiling prices would be applied at EU level.

A link between oil prices and carbon prices is already found in public discussion and the media.[33] There is higher resistance to carbon charges when oil prices are high. Indeed when high oil prices depress profits, the carbon abatement cost from reducing output, in terms of foregone profits, is low. Or expressed differently, at high oil prices, the price of carbon does not need to be very high to entice producers to reduce their emissions. Conversely, other things being equal, when oil prices are low profits are high, and altering the level of activity to reduce emissions sees large foregone profits. The carbon price would then need to be high to entice producers to reduce their emissions. We are talking in terms of these actions relative to each other. The implications are that the floor and ceiling on the permit price should be indexed inversely to the oil price. This would suit both producers and households (Helm, 2008b).

The means by which the floor price could be ensured are apparently straightforward. When the permit price falls below the floor a carbon tax could be activated to make up the difference. Another route would be for governments to buy back permits to raise their price, like central banks' open market operations, or "carbon market operations" in this case. If the permit price rose above the ceiling price, a negative carbon tax (a rebate) could be triggered. Among other possibilities is the option of allowing more CDM projects from developing countries. The broadening of the EU ETS requires consideration of such facilities in any event.

Any such decision to impose a price floor or ceiling would need to be taken at EU level, given that the EU ETS is managed by the European Commission. One argument against such measures is that price floors or ceilings could complicate any attempt to link the EU ETS to trading schemes in other parts of the world, which the European Commission has identified as a desirable next step towards a global carbon market (European Commission, 2009, p. 11). Any measures to contain costs would need to be compatible with the broader goal of expanding the carbon market. The scope for gaming between markets would also need to be addressed.

[33] Keenan (2008), in the *Irish Independent* put it thus: "To will the end, but not the means, is a common human condition… No one should have any doubt that dearer petrol, electricity, etc. is indeed the means by which carbon emissions will be cut. The question is whether governments should try to smooth what could otherwise be a highly disruptive series of booms and busts in both oil prices and economies." See also Gibbons (2008).

4.2.5 INDIVIDUAL CARBON TRADING

Individual carbon trading provides a form of emissions trading applied at the level of the individual: the ultimate expression of a downstream approach to a cap-and-trade emissions trading scheme. Individual carbon trading is based on the idea that the Earth's atmosphere is a common resource and each individual is entitled to an equal share of the benefits, that is, the benefits of being able to engage in activities like driving and heating that use the atmosphere's waste assimilation service. Under individual carbon trading everyone is given a limited allowance to cause CO_2 emissions, thereby allowing total emissions to be controlled while giving people an incentive – through the price signal and the ability to sell any unused emission permits – to reduce their emissions in their everyday consumer decisions. Everyone would be given an initial allowance, with the information stored centrally and perhaps on an individual credit card, and they would be required to retire equivalent credits whenever they make a carbon-emitting purchase, such as for petrol. The overall cap could be tightened over time and the price of individual emission permits would rise according to demand, or fall as cheaper technical solutions to abatement emerged.

Several models have been proposed with various design approaches to the practical issues posed by individual carbon trading, including tradable energy quotas, domestic tradable quotas and personal carbon allowances (Roberts and Thumin 2006, pp. 12-14). There are many uncertainties related to the political acceptability and economic impacts of such schemes and to their administrative complexity. "Cap and Share", a proposal developed by the Irish think tank Feasta, is a comparable approach to individual carbon trading but with a more upstream focus that requires fossil-fuel suppliers, rather than households, to surrender permits corresponding to their fuels supplied. Each resident or household receives an annual "entitlement" to an equal share of the overall cap in the form of certificates. Households can sell the certificates via an intermediary (banks or post offices) for selling on to fossil-fuel suppliers. These suppliers are in turn obliged to buy entitlements equivalent to the emissions from the fuels that they supply (Feasta, 2007). Unlike the individual carbon trading schemes outlined above, in Cap and Share the resident is not obliged to purchase additional entitlements if his or her annual activities cause additional emissions. Rather, the system causes the scarcity to lead to higher fuel prices (since the suppliers will pass on the cost of certificates via the cost of fuel to consumers), with the result that *average* users sell their entitlement for the same amount as their annual energy bills rise. Those who consume less energy than average will be better off, and those who consume more energy than the average will be worse off.[34] In this way the system acts like a carbon tax with a variable rate, with the revenues recycled via the intermediary to consumers.

[34] This is not strictly the case in the version analysed by Cambridge Econometrics (2008). The scheme covers the whole non-ETS sector, which includes businesses as well as households. The businesses in the version modelled by Cambridge Econometrics, while paying the carbon price on fuels, do not receive certificates in compensation. Meanwhile all households rather than just average households appear to gain (Table 4.7). This is because they are receiving the businesses' share of certificates. However, the carbon price passed on by businesses will erode some of the household sector's seeming gain, and the businesses themselves could be at a disadvantage.

The advantage of Cap and Share is that it could be effective, and (perhaps) simple to administer and politically acceptable. Because fossil-fuel importers or refiners are small in number and are currently covered by the excise duty regime, they can be easily monitored, so administration costs could be low. Fossil-fuel importers will then pass on the additional cost of buying permits to consumers in the form of higher fuel prices. All consumers are incentivised to use less, and although this effect may be small in the short-term if the elasticity of demand is low (see above), the longer-term effect may be strong if the annual cap is seen to be enforceable and increasingly restrictive in a predictable way. The scheme could be politically acceptable because the revenue goes via the intermediary to residents and not to the government.

A criticism of the Cap and Share proposal is that recycling the revenues effectively to individuals fails to "compensate the economy". The economy is disadvantaged by the high carbon price. In the case of carbon taxes, this can be more than overcome by directing revenues instead to reduce labour costs (by reducing social insurance contributions and income taxes) and thereby helping competitiveness. Using all revenue from taxes or auctioning to compensate households is less beneficial (Bergin *et al.*, 2004; Conefrey *et al.*, 2008) and the same would apply to Cap and Share.[35] There is also the risk that the scheme could allow rent-seeking behaviour if fuel suppliers are able to hoard fuel and sell for a profit during times of scarcity. Finally, any possible transaction costs should be factored into the design of the scheme: the experience of the all-island electricity market shows that transaction costs can generate large and unforeseen expense that could undermine the efficiency of the scheme. In terms of environmental effectiveness, an area where Cap and Share (and other individual carbon trading schemes) could be considered is for the transport sector, where carbon taxes might be a politically unpopular way to reduce emissions. A point to note is that abatement costs in transport vary widely between persons, whereas each tonne of CO_2 is equally damaging. If reducing emissions from transport is relatively costly in the ranked list of abatement actions then the priority attached to transport should be accordingly lower. However, superior policies may be available, including justified provisions of public transport and other measures such as improved spatial planning.

4.2.6 USER PRICING (TRANSPORT SECTOR)

The effectiveness of carbon taxation, at least in the short term, will be minimal where the price elasticity of demand is low. This will be the case where people use capital equipment that cannot be changed immediately. A prominent example in Ireland's case is transport. Road transport is already heavily taxed in Ireland, as elsewhere in Europe: German excise duty on petrol in 2006 was the equivalent of €275.20/tonne CO_2 equivalent (Convery and Redmond, 2007; Parry and Small, 2005). This is a multiple of carbon trading levels, although it should be noted that transport not only burns fuel but also imposes other external costs of road use (including air pollution, road wear, water-course pollution, severance of habitat, not to mention congestion and noise). There is a low elasticity of demand for

[35] Under the carbon levy only a share of revenue would be used and targeted at vulnerable households (Scott and Eakins, 2004; Callan *et al.,* 2009).

private motor transport in the short term.[36] An additional carbon tax of, say, €20/tonne CO_2, which would add just 4.22 per cent to the price of petrol (2006 figures) would, therefore, most likely not have a discernible impact on demand for travel and might bring few short-term benefits. Not pricing the externalities, however, means that the long-term benefits cannot be reaped and these could be significant. There are gains to be had by user charges, if mainly in the long run.

A more effective approach to transport emissions could be to charge all modes of transport directly, that is, as they drive, according to their total external social, economic and environmental costs, as recommended in recent reports to the UK and Irish governments.[37] Possible demand-side measures include congestion pricing and road pricing. A national road-pricing scheme that would charge users per kilometre driven, depending on location and time of day, is actively under consideration in the Netherlands with a view to nationwide implementation by 2016.[38] Availability of other alternatives such as public transport, correctly assessed, have a major role.

4.2.7 BORDER TAX ADJUSTMENTS

The threat to competitiveness from cheap "dirty" imports and fears about carbon leakage due to industries relocating abroad are often raised as objections to charges on carbon emissions. Under "free" trade, polluting industries that are subject to domestic carbon charges could be drawn to countries with lax environmental policies. These countries offer what amounts to a comparative advantage, in the form of "havens" for polluters. Other policies, for example direct standards such as emission standards, have cost implications too and thus affect competitiveness.

Where revenues from carbon charges have been recycled to reduce other taxes, the effects need not be harmful at national level (see above, the COMETR study and *ex ante* analyses of carbon taxes (Conefrey *et al.,* 2008)). Nevertheless, a few energy-intensive sectors – those revealed as having limited market power because they trade at world level – may require special attention. It would be pointless to cause such sectors to flee, only to set up abroad and continue polluting. Several studies have found statistically significant, though minor, pollution haven effects. Others have produced inconclusive results,[39] which is not surprising given the difficulty of disentangling the many factors, including proximity to growing markets, that influence location decisions. Such mixed findings highlight the

[36] It is sometimes claimed mistakenly that high fuel prices (e.g. in 2008) "show" that price has no effect, without regard to what demand *would* have been. In addition, elasticities are sometimes understated. Price-induced technological improvements are not unlearned in price downturns and this can reduce the measured price-demand effect.
[37] Eddington Transport Study (2006) and Oscar Faber (2000).
[38] "Road-use charge to reduce Dutch traffic jams". Radio Netherlands Worldwide, 1 December 2007. http://www.radionetherlands.nl/currentaffairs/071201-dutch-traffic-mc , see also study of mileage tax (Carroll-Larson and Caplan, 2009).
[39] Studies supporting the pollution haven hypothesis, if to a small degree, are seen in papers by Levinson (1996); van Beers and van den Bergh (1997); List and Co (2000); Ederington and Minier (2003) and Levinson and Taylor (2004). Studies showing that environmental policies had a favourable impact on competitiveness include papers by Berman and Bui (1999) and Kind *et al.*, (2002). A study by the IEA (2008) on the effect of the EU ETS on energy intensive industries to date did not find conclusive evidence of carbon leakage in affected sectors.

desirability of inducing host countries, via agreements, to strengthen their environmental policies, and of co-ordinating global environmental rules (Waldkirch and Gopinath, 2004).

Border Tax Adjustments are one possible solution, if permitted. They would consist of a tax on the pollution generated in the manufacture of imports coming into Ireland. By subjecting these imports to the same level of carbon taxes that were imposed in Ireland, the playing field is levelled. Similarly, if Ireland's exports to those countries were shown to be at a disadvantage owing to the carbon prices levied here in the course of their manufacture, they could receive an adjustment on export in the form of a tax relief or rebate. Such adjustments to the price at borders would apply to a few highly carbon-intensive sectors that trade on the world market and are revealed to be price-takers. Sectors such as cement that tend not to be price-takers may not need protection by border tax adjustments while steel, for example, might need protection of some sort (HM Treasury, 2006; Fitz Gerald *et al.*, 2009). The vast bulk of sectors are not sufficiently affected by charges on carbon to impact on their competitiveness. Border Tax Adjustments have already been applied in the US in the form of environmental excise taxes. A relevant instance was the Ozone-Depleting Chemicals Tax. This tax aimed to harness market forces in finding substitutes for the taxed chemicals, and their production was apparently discouraged by the tax in an effective manner (Zhang and Baranzini, 2004).

A border tax for Ireland would not be applied unilaterally but as part of an EU-wide application.[40] It could be levied on vulnerable sector products from countries that do not take part in an emissions trading scheme or do not put a price or other obligation on their producers to reduce carbon emissions. But there is currently little appetite for such measures at the EU level, from both the European Commission, which fears that it could lead to a trade war, and industry, which fears an increase in the cost of imported materials. The EU Climate and Energy Package adopted in December 2008 does not include border taxes except as a measure that might be adopted in the future as a possible alternative to the preferred outcome, which is a globalised carbon market via (for instance) an international carbon tax or a cap and trade scheme with auctioned permits operating at world level.41 In the meantime, competitiveness impacts are addressed through free allocation of emission permits to industries that are able to prove that they are exposed to leakage, according to a methodology to be agreed in 2010 (European Parliament 2008). On the other hand, the Waxman-Markey bill for a comprehensive US policy on climate change passed on 26 June 2009 includes border measures, if the President and Congress by joint resolution find that the preferred measure of providing rebates to affected companies fails to offset competitiveness impacts (US House of Representatives 2009).

[40] The 1957 Treaty of Rome established the customs union. External tariffs are set by the European Union rather than the Member States and there can be no tariffs on intra-EU trade, and thus no border tax adjustments either. Note that the bulk of Irish imports and exports are from and to other EU countries.

[41] Though operating internationally, revenues would accrue to national governments except insofar as an agreed share is used to avert deforestation, for example.

The legality of the issue hinges on whether such Border Tax Adjustments for carbon charges would comply with the rules of the General Agreement on Tariffs and Trade (GATT) under the World Trade Organisation (WTO). According to the rules, as long as there is no discrimination, the same taxes as those applied domestically can be imposed on like imported products, and a rebate of taxes can be awarded on exported domestic products. This kind of border tax reflects the application of the destination principle to products: products should be taxed in the country where they are consumed and not in the country where they are produced, unless they are also consumed there. Clearly, such adjustments are intended to ensure that internal taxes on products are trade-neutral.[42] The situation is more complex when the imported good is not the item that is taxed, but the energy or carbon emissions associated with the good's production are taxed. These are the emissions that are embodied or embedded, or the virtual emissions, in the product. To level the playing field, the energy or carbon embodied in the production of the imported steel, say, would need to be ascertained and verified – and the tax would need to be the same as on domestically produced steel.

The OECD argues that Border Tax Adjustments should be used as a last resort only, because BTAs could violate WTO rules and may lead to trade retaliation. For now, the OECD recommends that the focus be on achieving participation by all major emitting countries and sectors in an international agreement on emission reduction (Gurría, 2008). The European Commission likewise suggests exploring the options for allaying the competitive disadvantage of charges on carbon. The Commission cites possible internal or external solutions. An internal solution could entail differentiating the instrument applied to the vulnerable sector, among other possibilities. For example, carbon-intensive sectors could continue to receive free allowances as noted above. A possible disadvantage there is that entities could sell the allowances and relocate anyway and therefore agreements would need to be reached, perhaps with technical upgrades thrown in (US GAO, 2008b). With respect to possible external solutions, important elements that need to be resolved include WTO compatibility, retaliation, and the energy and carbon efficiency. The Commission notes that investments being made in emerging economies, often by European companies, could in any event be using state of the art clean technology. If no global agreement is reached for a post-2012 framework the EU might consider the possible use of border tariffs to equalise the effective "tax" on carbon in traded goods coming into and exported out of Europe. It will make proposals, at the latest by 2011 (Delbeke, 2008). However, as a substantial part of carbon emissions are not priced by a straight-forward tax but by a cap-and-trade system with some free permits, any border tax adjustment is likely to be challenged as being discriminatory. Much work would need to be done to flesh out these arrangements, but in the view of Nordhaus (2007) carbon tax and border adjustments are familiar terrain because countries have dealt with problems of tariffs, subsidies, and differential tax treatment for many years. "The (tax) issues are elementary compared to those of a quantity-based regime" he adds.

[42] This too has a precedent in the US with the Superfund Tax that was designed to place the burden of chemical clean-up in the US on those responsible for generating the wastes. Tax rates based on the US production were adopted by the US Secretary of the Treasury as the approach for the tax on imported chemicals (Zhang and Baranzini, 2004.).

The practicalities of border tax adjustments are briefly described as follows. According to one proposal, the level of tax on an imported product could be calculated as the additional costs of carbon permits incurred on procurement during production of the domestic equivalent product, using best available technology (Ismer and Neuhoff, 2004). The proposers claim that this would limit possible distortions and could be compatible with WTO constraints. They say that the crucial features are simplicity, which would be achieved by focusing on the CO_2 emissions caused by processed materials, and a separate treatment of electric energy input to take account of regionally varying fuel mixes. Of course, the tax could be less clear when the imports embody carbon that has been permitted for free in a cap and trade system. There is another uncertainty relating to the requirement that all "like" products be treated the same. If "like" applies to the final product, countries with carbon-intensive exports facing taxes on their embodied carbon might claim discrimination, which is why the destination principle could be the easier approach.

For Ireland, once these issues were settled such calculations of embodied carbon can be made by looking at the supply chain using Input-Output analysis, as reported in the section on trends, above.

In addition to arguing that a border tax can be compliant with GATT as in the suggested version above, Weber and Peters point to a second avenue that a country might use. That is, a country might simply admit that the border tax is incompatible with GATT and claim an exception through Article XX of GATT. Exceptions for environmental reasons are allowed. The article states that measures relating to "conservation of natural resources" or out of necessity to "protect human, animal, or plant life or health" are allowed if they are made in parallel with similar actions domestically (World Bank, 2007; Weber and Peters, 2009). The two precedents here have been controversial. Article XX was successfully used to block Canadian exports of asbestos intensive construction materials to France, and to block imports of shrimp to the US that had been caught by using nets that were harming turtles. If other WTO members were attempting to pass measures on climate policy that would invoke Article XX it may be easier to prove legality (Weber and Peters, 2009).

Nevertheless, the optimal solution for potential conflicts between WTO members would be to make the adjustment unnecessary. The harmonisation of emissions pricing across countries would eliminate grounds for border tax adjustments in the first place. Logically, the WTO should be rectifying the absence of carbon price (or similar), which, as already stated, effectively constitutes a subsidy for exports and an unfair practice, a description forcefully employed by Stiglitz (2006).[43] Such an internationally harmonised approach seems unlikely for now.

Alternatively, Weber and Peters suggest that in the short term "…the effectiveness of using the global trade network as a 'carrot', through technology sharing, collaborative research, global sectoral agreements, and freeing trade in environmental goods, may outweigh the effectiveness of coercive 'sticks'". They seem to imply that many sectors and not just carbon-intensive sectors would be affected and, in contrast to Stiglitz, they highlight the methodological and confidentiality concerns arising in calculating the carbon embodied in the vulnerable goods (i.e. primary goods apart). More importantly, they stress the present need to engage all countries in policy and, with self-serving behaviour in evidence, the mere perceived intent of border taxes may deter co-operation overall. Efforts to achieve such co-operation, they suggest, should include improving accounting for the carbon inventories by using the consumption based approach (for international transport included), or extending emissions trading-cum-CDM to bottom-up approaches, such as global sectoral agreements. (But note this could reduce the benefits of simplified targets, discussed above under the section on international project mechanisms.) In addition to massive amounts of capital to finance diffusion of green technologies, reduction of barriers to diffusion is also called for by the authors. They say this is not to deny the role of carbon tariffs in avoiding non-compliance in climate change mitigation policy in the long term. But the benefits of global cooperation are large and border taxes should not be allowed to impede it in any way.

4.3 Standards and Regulations

The use of direct government intervention through technical measures – such as regulations mandating appliance efficiency levels or the use of specific technologies – is often a cruder instrument than incentive-based measures. The state may be guided by political preferences rather than questions of economic efficiency or effectiveness when it chooses a particular technology as a response to climate change; governments are often poor predictors of technologies, simply because they are not omniscient. Technological developments would benefit from a guaranteed price of emissions, as technology has been bedevilled by uncertain carbon price up until now. Nevertheless, there are many cases that do call for direct government intervention or a mixture of instruments rather than leaving things to the market, especially in cases of clear market failure. For example, there are economies of scale in the provision of information in the area of energy efficiency. Savings are possible but many opportunities for reduced consumption remain hidden or otherwise unexploited.

[43] While the US was refusing to sign up to action on climate change, Stiglitz argued for a global enforcement mechanism, involving import prohibition or border taxes, to prevent any country from inflicting harm on the rest of the world. Citing the precedents, he stated that the principle that global environmental concerns could trump narrow commercial interests was sustained by the WTO. Biermann and Brohm (2005) also see world trade law probably permitting tax adjustments, despite uncertainties. Manders and Veenendaal (2008) meanwhile show that Stiglitz's proposal is unlikely to be effective as an enforcement mechanism. Though mitigating the generally modest negative effects of unilateral climate policy by the EU, the pain inflicted on non-EU regions by border trade measures would "not seem to be effective in persuading non-abating countries to join a climate change regime".

Reduced demand for energy or carbon-intensive fuels will be essential if Ireland is to move towards its long-term target (Fitz Gerald *et al.,* 2008).

4.3.1 ENERGY EFFICIENCY

Energy efficiency provides much scope for reducing emissions according to the estimate that at least 20 per cent of energy in the European Union is wasted (European Commission, 2006). The European Commission has defined an Action Plan with about 75 measures that can be taken to increase energy efficiency in appliances, buildings, electricity generation and the transport sector. Ireland could exploit some of these measures aggressively where they are the lowest-cost opportunities for reducing emissions. The energy saving potential of buildings in the European Union is estimated at 28 per cent and there is particular scope for savings in the public sector, where users of buildings generally do not have the incentive to use energy efficiently.

Early action on energy efficiency could be worthwhile, e.g. through the unilateral imposition of efficiency standards up to the cost-effective limit[44] for all buildings, regardless of size. Other measures include incentives for the development of passive houses, which rely on very good insulation levels and passive heating and mechanical ventilation rather than traditional heating systems, as well as measures to raise the efficiency of energy transformation, for instance by promoting Combined Heat and Power and district-heating schemes in urban areas. Vigorous assessment of the outcomes would inform the setting of standards. In addition, the appraisal of infrastructure projects such as foreseen under Transport 21 and the new Programme for Government should involve cost-benefit analysis to take into account the external costs and benefits of proposed projects including their impact on greenhouse-gas emissions. The correct share of public transport infrastructure options needs to be assessed in this manner.

4.3.2 SPATIAL PLANNING

Spatial planning and its consistent, effective implementation is a crucial policy area to address because of the long-term impact that settlement patterns will have on greenhouse gas emissions. This calls for a radical overhauling of Ireland's planning regime, which has to date led to the haphazard development of rural and peri-urban areas, and in turn has locked a growing proportion of the population into energy-intensive commuting patterns. Higher density need not imply unsightly heavy-handed developments, provided that they are designed with communities in mind (European Environment Agency, 2006).

4.3.3 ELECTRICITY GENERATION FROM RENEWABLE SOURCES

The Programme for Government foresees that at least one third of electricity consumed in Ireland will be generated from renewable sources by 2020 (Government of Ireland, 2007b, p. 16). This target is both ambitious and important if Ireland is going to meet its national emission targets. Political predictability is needed in this area because of the long investment horizon of the sector: generating stations typically have

[44] Costing in the external costs and benefits, as by Brophy *et al.* (1999).

lifespans of about 20 years or more and distribution networks have lifespans of about 45 years (Deloitte and Touche, 2005, p. 8).

Ireland has enormous and largely untapped resources of renewable energy. A 1997 study estimated that wind power could generate around 345 TWh per year, about 19 times the current electricity production of the ESB system, with the cost rising with the extent of penetration (ESBI/ETSU 1997). The recent grid study[45] shows that the type of grid is significantly different and more expensive if 6000 MW, rather than 4000 MW, of wind is to be accommodated. In the short term, however, the potential of renewable energy will not be realised without government support. Many new renewable energy technologies are relatively expensive because they are in their infancy. The structure of the electricity grid itself also imposes barriers to the wider deployment of renewable electricity. Irish electricity is structured around a number of large base-load plants, mainly combined-cycle gas turbine. Such plant has high capital costs, runs continuously at high output and is well suited for providing the electricity market with a guaranteed minimum supply, but it is inefficient when operated at part load, and it is expensive to start up and shut down and, therefore, inflexible and unresponsive to fluctuating demands. According to some estimates, there is more than double the required amount of base-load plant in Ireland to satisfy minimum system demand (O'Connor, 2006). This inappropriate generation mix has developed in response to rather crude market incentives rather than strategic planning.

The government could facilitate high penetration of wind energy (e.g. 30 per cent) by encouraging the deployment of open cycle gas turbine stations, which have a relatively low capital cost and provide the flexibility to balance the energy system when the wind drops (ESRI/EPA, 2004, p. 17). The most important and long-term challenge, however, will be to reorient the grid itself to allow the accommodation of greatly increased amounts of dispersed, often small generators of electricity from renewable energy sources (SEI, 2004, p. 20). "Embedded" or "distributed" generation is electricity generated in small-scale units that are connected to regional electricity distribution networks. Properly designed, a grid based on embedded generation could reduce greenhouse gases through improved efficiency and the accommodation of electricity from renewable sources while bringing additional benefits of improved security of supply, through fuel diversity and a more flexible grid that is less prone to blackouts (Goodbody Economic Consultants, 2002, p. 70). In Ireland there is much potential for flexible and new technologies such as modular combined cycle gas turbine, open cycle gas turbine, combined heat and power (large-scale, mini and micro) and fuel cells to be included in a national system of distributed generation. Micro-generation, which includes such technologies as domestic solar panels, brings embedded generation closest to the point of use. Combined Heat and Power (CHP, or the simultaneous production of electricity and usable heat, also known as cogeneration) would likewise benefit from a restructured grid. Though not necessarily based on renewable energy sources, CHP could also reduce greenhouse gas emissions by improving the efficiency of electricity conversion. The creation of a flexible electricity grid that accommodates major penetration

[45] http://www.eirgrid.com/EirGridPortal/uploads/Announcements/EirGrid%20 GRID25.pdf

of embedded generation will not happen without government intervention, however. For instance, it is often impossible for technical reasons to connect micro-generation and small-scale electricity generation to the electricity network.

A reorientation of the national grid to accommodate widespread renewable and micro-generated electricity would allow a large increase in the penetration of low-carbon forms of electricity generation, including micro-generation. This depends on a strong policy of technical intervention by government and the relevant authorities and is the subject of ongoing analysis. Such an intervention would not be to choose any specific technologies but rather to provide an environment in which many different kinds of technologies, including low-carbon ones, can compete. Such intervention could be justified because of the potential benefits and due to the national importance of the grid infrastructure. Short-term measures could include the introduction of a simplified protocol for connection to the grid and the introduction of smart metering, which would also promote energy efficiency by encouraging consumers to regulate their electricity consumption according to its price. Additional investment in interconnectors would also hedge against variability in output and allow Ireland to export as well as import electricity. In practice this can be less responsive depending on pricing arrangements which entail flows being determined one week ahead, for example. All these measures come at a cost. Nuclear power is unlikely to play a role in the generating mix without some government intervention, and a decision about any such intervention should be dependent on cost. Naturally nuclear energy should not be exempt from paying for its own particular external impacts such as end-of life, nuclear waste, monitoring and security costs that need to be factored in. Clarity on storage costs and site availability is required to indicate whether or not the end-of-life expenses could be more onerous than suggested. Ultimately customers need to bear such costs (Helm, 2008c). The choice of fuel used to generate electric power will become more important with the increasing number of plug-in hybrids and all-electric cars on the Irish roads. If such cars are connected to a smart grid, their batteries could serve to stabilise power supply and allow for a greater penetration of variable and unpredictable energy sources such as wind, wave and solar power (DECNR, 2006).

4.3.4 NUCLEAR ENERGY (DOMESTIC AND IMPORTED)

For reasons of investor security and the risk (though small) of a radioactive accident, a nuclear power station could not be built without government guarantees. As mentioned, in order to avoid inconsistent treatment of pollution, the costs of dealing with the waste and security would need to be factored in to the price of the electricity generated. Given that a nuclear power station takes about ten years to build, and no station has been proposed in Ireland, nuclear power is unlikely to play a significant role in Ireland's electricity mix (apart from some imported electricity) for the foreseeable future.

A pertinent objection to nuclear power is that it is the opposite of the kind of plant that is needed for the Irish electricity system. Nuclear power is currently not very economic in units below 700-800 megawatts, and its use would be limited to base-load plant, of which there is already a surfeit in Ireland (Bolger 2007; Lyons *et al.,* 2007). There may also be a trade-off between a centralised system that is made up of a small number of large generating stations and a more flexible, decentralised system made up of a large number of small generating stations, many of which would be based on renewable resources like wind or biomass and would be closer to the point of electricity use, as described above (Mitchell and Woodman, 2006). Finally, it is necessary to examine nuclear power's opportunity costs. Nuclear power is not currently cost competitive with other forms of electricity (although a 2003 MIT report suggested that nuclear power might be price competitive if the price of carbon rises to about $50-200/ton carbon: Ansolabehre *et al.,* 2003) and generally requires direct or indirect public support. The benefits of spending public money on a nuclear power station should be compared to the gains to be achieved by investing in energy efficiency or in non-technology specific measures like promoting a decentralised grid that accommodates embedded generation from a variety of different technologies. (These comparisons are facilitated through estimates for the schedule of marginal abatement costs.)

4.3.5 CARBON-INTENSIVE ELECTRICITY GENERATION: COAL AND PEAT

Besides peat, coal produces the highest proportion of greenhouse gases of any fuel, and large energy users are regulated by the EU Emissions Trading Scheme, which puts a cost on carbon and raises their electricity prices. The replacement of Moneypoint generating station with a gas-fired station would improve environmental performance, but this option has been rejected by the government to reduce over-reliance on gas and maintain diversity of energy supply. The environmental impact of coal could be reduced by CO_2 sequestration (also known as carbon capture and storage), a technology that is still far from being cost effective at current carbon prices. Peat is an indigenous source of energy that provides local employment, but its extraction can destroy ecological habitats and it emits even more CO_2 than coal. One solution would be to replace peat – and, eventually, other fuels – with biomass, which would retain the social benefits of local employment that are gained by using peat while also boosting the use of a renewable source of energy with fewer environmental impacts. However, even supplying 30 per cent of the current fuel used in peat stations with biomass would be likely to entail large imports.

The future viability of coal as a generating fuel in a climate change context depends on the afore-mentioned nascent technology of carbon capture and storage (CCS). The feasibility of ambitious climate targets may depend on the successful development of CCS as a cost-effective way of dealing with carbon emissions from coal, given the massive share of global electricity that coal provides (half of all electricity generation in the United States comes from coal) and its likely role in the future, given large global coal stocks. CCS refers to any process by which the CO_2 from coal combustion is captured from point sources like power stations and large factories, compressed into liquid form, transported to a suitable location and placed in permanent storage. Subterranean geological features are considered suitable for storage for many centuries with minimal risk of seepage and it could be based on the decades-old practice of injecting liquid into petroleum fields to increase oil recovery. The problem today is that CCS is an experimental process based on a complex stream of processes many of which depend on infant technologies. Demonstration projects reveal that CCS costs between $50 and $100 per tonne of CO_2 sequestered; this adds between $0.04 and $0.08 to the price of a kilowatt hour of electricity (Fernando *et al.,* 2008). CCS will, therefore, raise costs to consumers of electricity without providing any obvious co-benefits apart from reduced carbon emissions (the process of generating electricity by burning coal remains essentially unchanged). There may also be public resistance to CCS for several reasons including its cost, its "validation" of the continued use of coal for electricity generation, and the risks to ecosystems and human health from an accidental leakage of the captured CO_2.

To ensure that CCS is included in the panoply of policy and technology options available to address climate change there is a role for governments (including Ireland's) to help develop and demonstrate aspects of the technologies necessary for CCS such as storage, and a large-scale mandatory CCS project could be imposed as a condition for the future continued operation of Moneypoint coal-burning power station. In general, however, the most appropriate approach will be to place a price on carbon emissions through taxation or an emissions trading scheme. The International Energy Agency predicts that the cost of CO_2 capture could fall 50 per cent by 2030 to $25-50 per tonne of CO_2 (Fernando *et al.* 2008, p. 28). In the context of a carbon price this could make CCS an attractive option for investment. This should be a decision for private investors, not governments, but the government does have a role to play in the meantime by helping CCS demonstrate its applicability (if indeed it can be applied at scale) through supporting R&D and demonstration. Crucially, the government must also ensure that any CCS research or full-scale deployment in Ireland be bound by an appropriate regulatory regime that measures its performance as well as any impacts to ecosystems or human health.

4.3.6 INFORMATION

Regulations are also needed to ensure information is delivered through such mechanisms as eco-labelling to enable consumers to use their market power to reward green producers. Utilities in particular must make it possible for consumers to know what quantities they are buying and what costs they are incurring. Many barriers that deter would-be investors in energy efficiency can be overcome quite easily by the provision of reliable and relevant information Scott (1997); Sorrell *et al.* (2004).

4.4 Subsidies

Subsidies are a way to attempt to secure a particular outcome by incentivising favoured technologies or practices. Carefully designed subsidies can succeed in reducing greenhouse gas emissions if set in the right policy mix, but, precisely because they need to be carefully designed, they are prone to lead to unintended or suboptimal outcomes. Some subsidies are outright counterproductive in the context of climate policy, such as the requirement for Irish electricity producers to generate electricity from burning peat (one of the most carbon-intensive fuels). Some subsidies provide perverse incentives, like the subsidy provided until recently for public transport through a rebated tax on its fuel rather than on what should be encouraged, namely, passenger numbers; aviation has also benefited from a preferential and poorly targeted[46] tax treatment (Scott and Feeney, 1998). Subsidies are popular, however, because they give large benefits to small focused groups while dispersing the costs on society in general (Jaffe *et al.,* 2005).

Subsidies effectively make products or services cheaper than they would otherwise be. Direct subsidies are easy to observe and measure but indirect subsidies, which are less easy to define, have a significant impact. These include subsidies to production inputs, such as water, which is significantly underpriced in Ireland and encourages over-use and can give false signals to expand supply, with concomitant energy use. Although subsidies play a positive role in technology research and development discussed in the next section, they tend to be quite technology-specific and can be misused.[47] One major example is the set of subsidy structures in place for biofuels to help achieve target shares for their future use. EU subsidies to biofuels in 2006 were an estimated €3.6 billion, through Common Agricultural Policy payments and other measures. The Food and Agriculture Organisation's (2008) estimate of global support for biodiesel and ethanol is US$12 billion in 2006. This is excluding the costs of the side effects of the policy of subsidising biofuels, in diverting food to fuel thereby exacerbating demand from an already hard-pressed food supply, and putting pressure on land. Similarly, German subsidies to solar panels, via a feed-in electricity price, have raised the price of silicon, making solar panels expensive to install in more appropriate locations including Africa.[48] Germany is not a natural location for solar electricity and while a "success" in terms of take-up and illustrating the power of price, it also risks upsetting the comparative advantage of wind energy, with the temptation for subsidy leap-frogging. Subsidy policies are used as a way to sidestep addressing the real culprit of global warming directly, namely, carbon emissions.

In the absence of emissions pricing, subsidies to the adoption of new technology do not in themselves encourage reduced use of polluting technology. Furthermore, they can benefit the very products that ought ideally to be discouraged, by helping marginal firms and even encouraging new entrants, thereby increasing pollution. They can require large public expenditure per unit of effect, since recipients who would have innovated anyway may also receive the subsidy (the free rider or additionality issue). Another problem arises with the revenue that must be raised to finance subsidies, especially when they entail a transfer from tax-payers to fund subsidies to upgrade homes that raise the value of private houses. Ireland's targets are onerous to the extent of having potential macroeconomic effects, but raising taxes to fund subsidies distorts the allocation of resources and moves the economy away from efficient allocation. The cost of the subsidy is not just its value, but the extra cost of funding. Studies for

[46] This subsidy has now been removed. A targeted measure is one that is correctly applied at the point of decision to pollute or not to pollute (or as close as possible to it), e.g. whether or not to use another litre of water, petrol, or get a plastic bag etc. At this point the user can make a difference to the amount of tax they pay and the effect they have on the environment.

[47] The subsidy may be guided by estimates in the MAC, but the cost of abatement in individual cases is ultimately unknowable until tried. Sectors in the UK, threatened with a carbon price, in many cases abated far more than expected (Salmons, 2007).

[48] "More heat than light", *The Economist*, 7 April 2008.
http://www.economist.com/world/international/displaystory.cfm?story_id=10989479

Ireland put the adjustment factor at well over 1 for multiplying the nominal cost of a subsidy to establish the true cost (Barrett *et al.*, 1997; Honohan and Irvine, 1987).

Notwithstanding the above, there is a role for subsidies in a well-designed policy mix. Cost-effective technologies that are not widely installed could be suffering an information failure and subsidised energy audits that recommend energy-saving projects can help overcome this. A feed-in tariff for renewable electricity can drive the deployment of new technologies to help them achieve economies of scale, although the German example showed the danger of setting the subsidy too high. All the while systematic assessment of subsidy outcomes is recommended (Jaffe *et al.*, 2005). In addition, public funds could be made available through grants (e.g. administered by Sustainable Energy Ireland), to direct investment in energy efficiency, renewable energy and low carbon emission projects, and also to provide a source of capital available to banks and lending institutions to subsidise low-interest loans to companies that are seeking finance for projects to deliver low carbon or renewable technologies.

4.5 Research and Development Policy

The market failure associated with the emissions externality has already been discussed, but the existence of a second market failure must be emphasised, which is summed up as the occurrence of knowledge spillovers. These spillovers are the results of investment in R&D and of learning by doing and information. These results are externalities, but of the positive kind, requiring market corrections, in the form of subsidies to R&D and production subsidies for demonstrating renewable energy to rectify their under-provision. The positive gains are often not captured by those who invest in the R&D (Bazilian *et al.,* 2004; Morgenroth and Fitz Gerald, 2006; Ryan and Turton, 2007). In the UK a decline in R&D activity occurred at the time of reforms to promote competition in the electricity sector, because the fruits of their investigations would now be shared by other parties (Scott and Evans, 2007). The resulting under-investment and lack of development and demonstration of new technology can be rectified by government subsidies. Investment in R&D itself may be doubly under-provided unless there are market corrections dealing with both externalities, which pay for the spillover benefits and put a value on technology's output, namely, carbon reduction.

Optimal correction of two such market failures requires more than one single policy and the issue of policy mix has received attention recently (Jaffe *et al.,* 2005). In a study that assesses policies for reducing emissions and promoting renewable energy in the US electricity sector, Fischer and Newell (2008) find that, due to knowledge spillovers, optimal policy performance involves a portfolio of different instruments. They judge optimality by various criteria: economic surplus,[49] emissions reduction, renewable energy production and R&D. The authors find that an optimal portfolio of policies can achieve emissions reductions at a significantly lower cost than any single policy, although the reductions continue to be due *primarily* to the emissions price. In particular, they show that an emissions price alone, although the least costly of the single policy levers, is

[49] The economic surplus is measured as the environmental benefits net of the sum of changes in consumer and producer surplus and revenue transfers from subsidies and taxes.

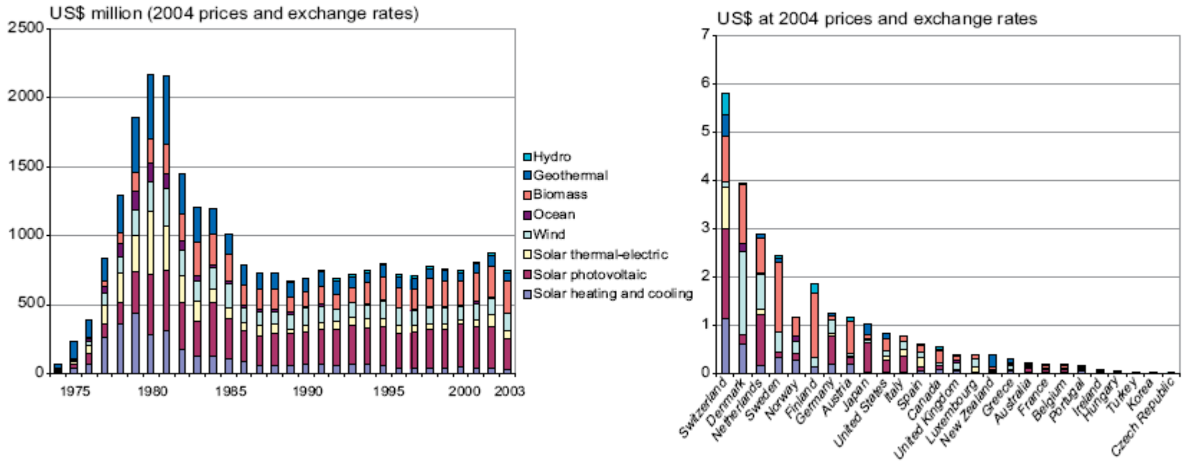
significantly more expensive alone than when used in combination with optimal knowledge subsidy policies. Also the burden on consumers may be large if they do not benefit in some way from revenue transfers (a problem of granting permits for free as opposed to bringing in revenue by auctioning them, discussed under the section above on emissions trading). Importantly a renewables research subsidy on its own is the most costly single policy for reducing emissions, and a renewables output subsidy is the next most costly, though much less so.[50] With the combination policy, the required emissions price is much more modest.

Fischer and Newell point to some clear principles that emerge from their study. Under the ultimate goal of reducing emissions, policies that create incentives for fossil-fuelled generators to reduce emissions intensity, and for consumers to conserve energy, perform better than those that rely on incentives for renewable energy producers alone. A renewable energy R&D subsidy on its own turns out to be an inefficient means of emissions reduction, in so far as it postpones the majority of effort to displace fossil-fuelled generation until after costs are brought down by R&D. In the absence of conservation incentives and emissions pricing in particular, it requires very large R&D investments and forgoing near-term cost-effective abatement opportunities. They state that their results emphasise the importance of policies that encourage abatement across all available forms and timeframes, as well as highlighting the limitations of narrowly targeted policies, particularly those focused solely on R&D.

Research is a major area for state subsidies in Ireland, attracting €8.2 billion of funding in the 2007-2013 National Development Plan. The establishment of the Irish Energy Research Council in 2006 establishes a strategy for research in the energy area, but Ireland has historically spent less, per capita, on research and development of renewable energy than its OECD peers (see Figure 4). Current policy is intended to develop a more competitive contribution from indigenous, and in particular, renewable energy sources as well as improvements in energy efficiency in transport, energy-supply systems, buildings and industry (Government of Ireland 2006, p. 160). An example might be ocean energy from waves or tides, which is abundant around the island of Ireland and, because tidal power is predictable, could provide a backup source of energy to support wind power (DCMNR, 2005; SEI, 2004, 10). To contain risk, the research needs to be shared with other countries and ought to include systematic updates of the known and expected comparative costs of emissions abated by different technologies.

[50] The paper concentrates on the mid-term, but the authors point out that R&D focused on breakthrough technologies could have greater salience in the context of deeper long-term emissions reductions.

Figure 4: IEA Member Government Budgets for Total Renewable Energy R&D Annual Investments for 1974-2003 (left) and Investment Per Capita, Averaged Between 1990 and 2003 (right)



Source: Sims *et al.* (2007), p. 314, reproduced from International Energy Agency.

Regular reviews of the State's research and development and its budget, foreseen under the National Development Plan, would help to maximise the synergies with Ireland's climate-change goals. Prioritised according to potential savings in abatement costs, research across a broad range of technologies can be promoted. One should keep in mind, however, that subsidies to R&D reward effort rather than success. R&D subsidies are therefore no substitute for a carbon price, which itself would also stimulate R&D.

5. CONCLUSIONS AND POLICY IMPLICATIONS FOR IRELAND

The economic recession from 2008 means that the path of Ireland's greenhouse gases is now probably close to complying with its Kyoto commitment for 2008-2012. The segment of the economy already covered by the EU ETS will automatically be in compliance and so the area of uncertainty lies in whether and how many foreign credits will need to be purchased to cover emissions from the remainder of the economy. Compliance with respect to the stringent 2020 goals set by the European Union may also have become somewhat easier, although the extent depends on the timing of the economic recovery.

The pause in growth presents not merely a breathing space but a valuable opportunity for the Irish government. Political parties can focus on the longer-term strategy and determine how to provide the appropriate context for building a sustainable economy. Although national emissions contribute only a small fraction of global emissions, meeting its EU and UN obligations could be important for the country in order to avoid the image of free-riding on the efforts of other nations. Moreover, Ireland could enhance its standing and perhaps even lead the way by demonstrating what can be achieved by intelligent policies that focus properly on emissions reduction and avoid many usual routes that waste resources in that pursuit. The task is still demanding and therefore efficient approaches are needed.

This paper has set out some of the policy options that are available to the Irish government in 2009 to reconcile its emissions obligations with its aim for economic growth. The issue is not so much the technical feasibility as how to "make it happen", to quote the UK Committee on Climate Change.[51] There are many ways to reduce emissions; the point is that the costs of doing so are subject to a wide range. The task involves recognising that the finite resource in question is the planet's capacity to absorb emissions. This limited absorptive capacity, like any beneficial resource or factor of production, is inevitably used to the extent that individual entities gain by doing so. Our emissions reflect our acquired infrastructure and way of life and it was natural to use increasingly more of this "absorptive capacity" as it was free. Policies must address this absence of price, the root

[51] Committee on Climate Change, 2008, p/xiii.

of the problem, otherwise they will be straining against human nature. This issue cannot be ducked if we wish to avoid spending sizeable sums of taxpayers' money on policies with disappointing results.

Nevertheless, it seems commonly accepted that the introduction of ideal solutions is constrained by political preferences, the inertia of economic sectors and the demands of public opinion. It is indeed difficult for government, stakeholders and citizens to become conversant with the empirical work on the best combination of different instruments and measures. More expensive measures may satisfy a political ideal, but such decisions, if taken, should be the result of an open process and a proper understanding of reasons and of costs and benefits. There may be a case for choosing a more expensive approach to ensure equity to vulnerable members of society, for instance, though clearly not if there are better ways to protect them or if it is merely kinder to a valued political constituency at the expense of society as a whole. An open process that is subject to public scrutiny and appraisal of alternatives is less likely to be abused in such a way.

As a general approach, we recommend the following criteria and priorities:

1. *Regulatory certainty*: Government should establish the necessary credible long-term political certainty to guide investment decisions and other areas of government policy. Such certainty reduces risks and creates an environment conducive to long-term decisions. To this end, the government should promote wide understanding to encourage agreement on Ireland's target beyond 2020, indicative short-term interim implications and the policies to meet such targets. Using evidence-based research and estimates of abatement costs, such a policy consensus should be struck with all- or nearly all-party agreement and should be based on a process of consultation and stakeholder involvement along the lines of the Social Partnership Agreements. The need for a framework that facilitates adoption of the best abatement options, which may not really be known, or even knowable, will then become clear. The envisaged Commission on Climate Change as foreseen in the Programme for Government would play a central role. It should be able to remove decisions on climate policy from short-term political considerations, and may one day achieve an independent position. Without fear of vested interests it should be able to present policies that are best for the economy while safeguarding the vulnerable.

2. *Clearly defined incentives*: Given the nature of the underlying problem, a key requirement is to ensure a credible long-term price of carbon. Would-be investors in abatement technology cannot operate properly without this reassurance. To avoid worthwhile carbon reduction opportunities being overlooked as at present, every emitter, that is, everyone, needs to be faced with this price, not just those entities that operate in the EU Emissions Trading Scheme. Where carbon prices currently apply, that is in the EU ETS, they are determined by the abatement costs of the scheme's participants and the targets, which are short-term targets. If it is found that having a broader pricing regime is still insufficient to drive the

target decarbonisation of the Irish economy, complementary measures would be required to deliver carbon reductions in specific sectors of the economy in an efficient and equitable way. These measures will be helped with the correct incentive pricing, rather than hindered by its absence as at present.

3. *Transparent, dynamic and fair process*: The process by which Ireland reduces its greenhouse gas emissions is similarly important. The Commission on Climate Change should oversee the formulation and implementation of the national climate-change strategy, which should be entirely open to input from stakeholders and the general public. It should be accompanied by a regular public reporting method to reveal the performance of individual economic sectors and government departments/policy areas. Appraisals should take all costs including environmental costs into account in a consistent manner; to this end the Commission should update and extend assessments of detailed abatement opportunities and actions across the economy to demonstrate options and their associated costs. To the extent that intermediaries would automatically satisfy the demand for this analysis under correct carbon pricing, the Commission's role would be to ensure that gaps are addressed and the integrity of information is upheld. Relative costs of domestic versus foreign schemes for reducing emissions should be explicit and the Commission should keep abreast of technical potential, costs and international policy processes. It should devote significant effort to gain public support for climate change measures across all segments of society with correctly pitched information. Transparency also requires that revenues arising from the price imposed on carbon are tracked. Because carbon revenues (including windfalls from grand-parented permits) derive from the planet's "common resource" these revenues should accrue to government. This is needed for national use to shield the vulnerable according to need and to help the macroeconomy. The macroeconomy is best helped by using the revenues in such areas as protecting competitiveness and reducing employment costs in particular. Sub-optimal use of revenues adds to policy cost and needs to be resisted.

How do the policy options considered in this paper perform on these criteria? The main ones are outlined now.

Regulatory instruments have an important role to play, especially in areas where individuals do not have expertise, such as in building standards, or where a framework for development is needed that considers the common good, especially for the long term, notably spatial planning and urban design. Other instances occur where individuals are discouraged from installing energy efficiency measures because they cannot reap a direct benefit, e.g., landlord's properties require regulation as do other instances of a principal-agent relationship. It is easy for standards to multiply, explode even, if they aspire to deal with every situation and action. Standards and regulations can impose widely different carbon reduction costs, including administration costs, on individuals and entities. Some actions forced on people can be expensive in their case and some cheap actions are omitted – such variation in abatement cost violates criterion 2 above and risks raising abatement costs overall. On the other hand, some regulations may be worthwhile in any event and may provide valuable information in to the bargain, e.g., Building Energy Ratings. This of course can be validated by appraisal based on an explicit carbon price.

Market-based instruments by contrast, put a price on carbon emissions. These include subsidies, emissions trading schemes and carbon taxes. The extent to which they secure a credible long-term price and encourage best actions, and the manner of their impact on the macroeconomy and vulnerable groups, will differ according to the instrument chosen and manner of application.

Subsidies usually reward inputs and do not directly put a price on emissions. Ensuing emissions reductions *per se* are brought about at a high cost that has to be funded by the general tax-payer. Unless subsidies are in some manner awarded according to an amount of carbon saved, their incentive properties can be weak and they are an expensive way to reduce emissions. The application of subsidies is called for in the case of bodies that are capital-constrained, such as low-income households. An area where subsidies can pay off is in the field of knowledge and information. There are economies of scale in gathering technical information about energy efficiency. Subsidies to information agencies, for example, are worthwhile in order to reduce the barriers, such as unfamiliarity and hassle, to would-be private investors. The form and relevance of information also matter: case studies help if people recognise that they are relevant to them. Research and Development also provide external benefits that merit subsidies.

Turning to *emissions trading*, the EU ETS has provided valuable information from which much is being learned. In order to control volatility in the price of carbon permits and thus satisfy criterion 2, a floor price and a ceiling price may be considered if it could be made consistent with other policy goals such as an international carbon market. To satisfy fairness as in criterion 3, permits should be purchased at auction from the State. This would level the playing field for incumbents and new entrants and would enable correct use to be made of funds accruing from carbon pricing. Freely allocated permits are a transfer from the people to the recipients of permits. The problem is not rectified by then requiring the recipients to undertake social functions that sit uncomfortably with their interests, such as the requirement that UK energy utilities help their customers use less energy, for example.

Carbon taxes satisfy many of the desired criteria. They can provide a credible long-term carbon price and they automatically reward climate-friendly behaviour (including investment, R&D and recycling). They provide revenue that enables "environmental tax reform", that is, the revenue can be used to help competitiveness and employment while also supporting vulnerable groups according to need. In the special case of vulnerable industries, it is found that these can respond well to negotiated agreements. Protection of domestic industry by means of border tax adjustments is a less favoured approach, though pilot work that can help estimate their levels should be and has been done. There are merits to carbon taxes during a fiscal contraction, when they can replace other relatively damaging tax hikes. Moreover, where carbon taxes have been applied they have not been found wanting, either in terms of economic effect or emissions reduction. They can be operated alongside the emissions trading scheme in which a floor and ceiling are imposed on the price of permits, in a "hybrid ETS". The requirement of a common price can be satisfied if the rate of tax is related to the forward price of emissions permits. Political interference violating criterion 1, for example to reduce the carbon tax burden during recessions, has its counterpart in an emissions trading system, where it is likely to influence how the cap is shared out.

In brief, these are the main instruments that governments have to hand and it is important to ensure that the instruments work together. The EU ETS is established for now and it controls 30 per cent of emissions, and Phase III adopts some of the necessary improvements to the scheme. The effect of these would be to provide a more credible long-term price of carbon, to which a carbon tax applied to the remainder of the emissions would need to be linked with maximum flexibility allowed between them. Regulations have specific roles to play but subsidies are an expensive approach.

This synthesis report discussed the main policy options for reducing Ireland's emissions and attempted to clarify some of the issues. In sum, Irish society as a whole will have to pay more if the best policies, and the best mix thereof, are not used. Less efficient policies increase the costs of achieving a given target and reduce the ability of the government to drive Ireland's development in a more sustainable direction.

ANNEX 1: ANNUALISED EMISSION REDUCTIONS

Year	3% Annual Reduction ($MtCO_2e$)	% of 1990 Baseline %	4% Annual Reduction ($MtCO_2e$)	% of 1990 Baseline %
1990	55.08		55.08	
2007	69.21	126	69.21	126
2008	67.13	122	66.44	121
2009	65.11	118	63.78	116
2010	63.16	115	61.23	111
2011	61.27	111	58.78	107
2012	59.43	108	56.43	102
2013	57.65	105	54.17	98
2014	55.92	102	52.00	94
2015	54.24	98	49.92	91
2016	52.61	96	47.93	87
2017	51.03	93	46.01	84
2018	49.50	90	44.17	80
2019	48.02	87	42.40	77
2020	46.58	85	40.71	74
2021	45.18	82	39.08	71
2022	43.82	80	37.52	68
2023	42.51	77	36.01	65
2024	41.23	75	34.57	63
2025	40.00	73	33.19	60
2026	38.80	70	31.86	58
2027	37.63	68	30.59	56
2028	36.50	66	29.37	53
2029	35.41	64	28.19	51
2030	34.35	62	27.06	49
2031	33.32	60	25.98	47
2032	32.32	59	24.94	45
2033	31.35	57	23.94	43
2034	30.41	55	22.99	42
2035	29.49	54	22.07	40
2036	28.61	52	21.18	38
2037	27.75	50	20.34	37
2038	26.92	49	19.52	35
2039	26.11	47	18.74	34
2040	25.33	46	17.99	33
2041	24.57	45	17.27	31
2042	23.83	43	16.58	30
2043	23.12	42	15.92	29
2044	22.42	41	15.28	28
2045	21.75	39	14.67	27
2046	21.10	38	14.08	26
2047	20.46	37	13.52	25
2048	19.85	36	12.98	24
2049	19.26	35	12.46	23
2050	18.68	34	11.96	22

ANNEX 2: CARBON TAXES AT RATES RANGING FROM €5 TO €30 PER TONNE CO_2

Possible Carbon Tax Rates (Euro Per Tonne of CO_2)	5	10	15	20	25	30
	Carbon Tax (Euro Per Unit)					
DOMESTIC						
Premium Unleaded Gasoline 95 RON (litre)	0.01	0.02	0.04	0.05	0.06	0.07
Automotive Diesel – Non-Commercial User (litre)	0.01	0.03	0.04	0.05	0.07	0.08
Natural Gas – Household (kWh)	0.001	0.002	0.003	0.004	0.005	0.006
Electricity – Household (kWh)	0.003	0.006	0.009	0.012	0.015	0.018
Light Fuel Oil – Household (1,000 litres)	13.42	26.83	40.25	53.67	67.09	80.5
Briquettes (bale)	0.12	0.24	0.36	0.48	0.60	0.72
Premium domestic coal (tonne)	14.08	28.16	42.24	56.32	70.40	84.47
COMMERCIAL						
Automotive Diesel – Commercial User (litre)	0.01	0.03	0.04	0.05	0.07	0.08
Natural Gas – Industry (10**7 kcal GCV = TOE)	11.89	23.78	35.67	47.56	59.45	71.34
Electricity – Industry (kWh)	0.003	0.006	0.009	0.012	0.015	0.018
Light Fuel Oil – Industry (1,000 litres)	13.42	26.83	40.25	53.67	67.09	80.5
High Sulphur Fuel Oil – Industry (tonne)	15.67	31.34	47.01	62.68	78.35	94.02
Jet Fuel (litre)	0.01	0.02	0.04	0.05	0.06	0.07
Marine Diesel (litre)	0.01	0.03	0.04	0.05	0.07	0.07

Notes: Figures are subject to rounding.
Emission factors from Environmental Protection Agency (EPA) and Sustainable Energy Ireland (SEI).

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