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**RECONCILING RAPID ECONOMIC GROWTH AND ENVIRONMENTAL
SUSTAINABILITY IN IRELAND**

J. PETER CLINCH*
University College Dublin

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Abstract: The extraordinarily rapid rate of growth of the Irish economy in the past decade has provided many benefits in terms of increased living standards and higher employment levels. However, economic growth has also resulted in increased pressures on the environment. This paper sets out to examine how the environment has fared over the period of unprecedented economic growth, and specifically, if the country's environmental endowments have been improved or diminished by the substantial rise in income and wealth generated. Ireland's economic performance is summarised. Alternative definitions of environmental sustainability are examined briefly. The 'weak sustainability' test is presented to assess how Ireland is faring from a macroeconomic perspective. The reliability of this test is assessed by looking, in a more detailed way, at individual indicators and their association with growth. The paper then turns to an assessment of environmental issues, including meeting: the Kyoto greenhouse assigned amounts; the acidification precursor amounts assigned via the Gothenburg Protocol; water quality objectives; waste emission reduction, recycling and re-use targets; accommodation needs. Individual attention is also given to the integration of environment and development in the following sectors: transport, energy, agriculture and forestry, tourism and industry. The paper outlines the salient features with regard to the environment of the existing policy mix. Finally, it examines what changes in environmental policy are likely to be desirable, with a particular emphasis on how market forces might better be mobilised to achieve environmental objectives.

Keywords: Economic Growth and Environmental Policy, Sustainable Development.
JEL Classifications: O130, Q280, R110.

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1. INTRODUCTION

Just less than a decade ago, Danny McCoy presented his Barrington Prize Lecture (McCoy, 1992) entitled *Sustainable Development: the Challenge to Irish Policymakers* and observed that "Irish policymakers have accepted a formidable challenge in adopting sustainable development as the future objective of economic policy". At the time of his lecture, Ireland's economy was just emerging from a period of economic stagnation. Ireland is now an economy, which in a European context, has been growing at a phenomenal rate for most of the past decade and it is interesting, almost 10 years on from McCoy's paper, to revisit the topic and to examine how the environment has fared over this period. Specifically, this paper examines whether the country's environmental endowments have been improved or diminished by the substantial rise in income and wealth generated.

There is no attempt to provide a formal expression of an environmental Kuznet's curve¹, tracking the relationship between economic growth and environmental performance, but some insights are provided in this regard. Irish economic performance is firstly summarised. The various definitions of environmental sustainability are then examined. The 'weak sustainability' test is employed to assess how Ireland is faring from a macroeconomic perspective, using data developed at the World Bank and the appropriateness of this measure is discussed. The paper continues by looking, in a more detailed way, at individual indicators and their association with growth. It then turns to an assessment of environmental issues, including meeting: the Kyoto greenhouse assigned amounts; the acidification precursor amounts assigned via the Gothenburg Protocol; water quality objectives; waste emission reduction, recycling and reuse targets; accommodation needs. Individual attention is also given to the integration of environment and development in the following sectors: transport, energy, agriculture and forestry, tourism and industry.

The institutions and the policies that have been mobilised to integrate economic and environmental performance are examined. The *National Development Plan, 2000-2006* is the main political and institutional expression of Ireland's proposed response to the challenges posed by growth, at least in so far as those policy responses involve investment. The paper outlines the salient features as regards the environment, and looks to the future to see what are the implications of the existing policy mix, and what changes in the latter regard are likely to be desirable, with a particular emphasis on how market forces might better be mobilised to achieve environmental objectives.

2. ECONOMIC GROWTH AND ENVIRONMENTAL PERFORMANCE – A MACRO VIEW

The Irish economy has been the fastest growing in Europe for the past 8 years. Annual Gross Domestic Product rose by over 60 percent over the 1990 to 1998 period, industrial output more than doubled, visitor numbers from overseas rose by over 75 percent, and retail sales rose by almost 40 percent. Of the main economic sectors, only agriculture remained relatively static, showing a 3 percent rise.

Table 1. Some Economic Indicators, Ireland, 1990 and 1998.

<i>Indicator</i>	<i>Annual Output in 1990</i>	<i>Annual Output in 1998</i>
Real Gross Domestic Product (Index)	100	161.4
Real retail sales volume	100	139.8
Agriculture (Index)	100	103.0
Industry (Index)	100	202.7
No. of overseas visitors (Index)	100	175.5
Cars registered (Index)	100	168.3
New houses completed (Index)	100	221.9
Electricity output (Index)	100	143.0
Unemployment rate (% in 2000)	13.3	4.4
Total population (Index)	100	105.7

Sources: Derived from: Baker, Duffy and Shorthall (1998), pp. 36, 39; Institute of Public Administration (1999), p. 404; McCoy, Duffy and Smyth (2000), pp. 75, 85; Personal communication, Bord Fáilte (Irish Tourist Board), CSO (2000).

How has this dynamism affected environmental sustainability? In order to address this question, a working definition of environmental sustainability must be established.

3. WHAT DOES ENVIRONMENTAL SUSTAINABILITY MEAN?

Ekins (2000) provides an excellent synthesis on economic growth and environmental sustainability from which much of this brief discussion is drawn. There is disagreement within the economics discipline, and even more so, between disciplines, on the concept of environmentally sustainable economic growth. For example, Daly (1990) views sustainable economic growth as an oxymoron whereas Goldin and Winters (1995) view economic growth and environmental protection as perfectly consistent. One's opinion should depend largely on the definition of 'sustainability'. This makes it all the more unhelpful that people generally, and politicians in particular, make widespread use of the term without explaining what they mean by it.

In the early 1970s, the concern was that economic growth would be limited by ecological constraints (the 'limits to growth' literature – see Meadows *et al.*

(1974)). Whether one is convinced or otherwise by the limits to growth literature depends more or less on one's opinion as to substitution possibilities (e.g. the practicality of renewable in place of non-renewable energy sources) and the ability of humans to sustain technological progress (Lecomber, 1975).² However, environmental economists would believe that, rather than manipulating economic growth directly to reduce the possibility that, as Meadows *et al.* (1974) described it, a "*sudden and uncontrollable decline in both population and industrial capacity*" might occur, policymakers should introduce a surrogate price on environmental goods that are free (e.g. for emissions to air) to reflect such (potential) damage.³

Ultimately, physical sustainability is limited by the second law of thermodynamics. The entropy law tells us that complete de-coupling of economic growth and the production of waste can never occur. However, many economists believe that the gap can be narrowed continuously by innovation and substitution in the time period of relevance to human existence. However, it is important to note that, even if there is a limit to physical sustainability, it is not necessarily optimal to restrict economic growth. The net benefits of development may outweigh the ultimate costs of physical unsustainability (particularly if externalities are internalised), i.e. the long-run destruction of environmental resources may be optimal. However, this controversial suggestion depends on how we trade-off the future against the present ('discounting', which is of huge significance in the global-warming debate). Therefore, there may be a conflict between economic and environmental policy, although, to environmental economists, these policies should never be considered as separate.

Hirsch (1976) believes that the efforts of those who advocate a sudden crisis point being reached far in the future are misplaced. Rather, the concern should be with the overall welfare of society. Mishan (1977) puts this most strongly when he postulates that economic growth will actually end up reducing the welfare of society because of the negative externalities (spillovers) produced such as the declining architectural endowment, increased noise, and even "sexual deviancy"! However, as mentioned earlier, environmental economists advocate a number of means of attempting to strike an appropriate balance such that the net benefits to society are maximised. These "means" are discussed briefly in the policy recommendations at the end of this paper.

I am in agreement with Hirsch that the key is to ensure that people's quality of life is sustainable. This is the focus of the economics literature on environmental sustainability. Pearce *et al.* (1989) and Pezzey (1989) define sustainable development as some indicator of well-being that does not decline over time. The issue of intergenerational equity and the difficulty of knowing the preferences of future generations now emerges as an issue. Leaving this aside for the moment, if we assume that we can develop such indicators of well-being, the discussion moves on to the conditions required to satisfy this concept of non-declining well-being. The Hartwick (1977) Rule prescribes that rents from the exploitation of renewable resources should be invested in order to ensure constant consumption over time.

Solow (1986) and Mäler (1991) view a constant capital stock as a necessary condition for ensuring constant consumption.

The issue then revolves around the sort of capital we have in mind. Pearce and Atkinson (1995) see the overall capital stock as consisting of man-made (reproducible) capital (such as machines, buildings, roads), human capital (the knowledge and skill of people), and natural capital (which delivers ecological services). 'Weak Sustainability' is achieved when the overall capital stock does not decline whereas 'Strong Sustainability' involves conserving certain components of the natural capital stock while ensuring that the overall capital stock is sustained (Pearce *et al.*, 1996). 'Ecological' (as opposed to neoclassical 'environmental') economists, who favour the goal of strong sustainability, tend to use the concept of 'carrying capacity' which is defined in terms of ecological limits or 'sustainability constraints'. Such constraints include that pollution should not exceed the assimilative capacity of the environment and that the harvest of renewable natural resources should not be greater than natural growth (Pearce *et al.* 1996). A further concept of sustainability that is often used relates to environmental policy constraints. A good example is whether energy use in Ireland is 'sustainable' from the point of view of our commitments under the Kyoto and Gothenburg Protocols, i.e. would current energy use allow us to stay within these policy constraints? The latter definition, which could perhaps be called 'Weakest Sustainability', is likely to be seen by Irish policymakers as the most urgent priority.

Having defined three different forms of sustainability, I now must choose one for the purposes of this paper. It is impractical and sub-optimal to "preserve everything". Following a weak sustainability path would involve the creation of services from other forms of capital which would compensate for the decline in natural capital. To be a practical concept, strong sustainability would involve preserving certain proportions of natural capital to ensure that the real value of the stock is not at a level below which it would be unable to provide critical ecological services. To achieve strong sustainability, the precautionary principle would be invoked to avoid potential irreversibilities, uncertainties and to achieve minimum viable scale in ecological services (see Pearce *et al.* (1996) for explanations). Following from the belief that it is the sustainability of the quality of life of people that should be the ultimate objective, I favour using the weak sustainability test.

Before examining available data, it is important to note that, as mentioned previously, a scenario could be envisaged where strong or weak sustainability is sub-optimal (such as in the case of very high discount rates). Therefore, it is important to consider what is the appropriate trade-off between income and environmental quality. Cost-benefit analysis that incorporates environmental valuation⁴ is a means of assessing the trade-off between natural and man-made capital. There are extraordinarily few Irish studies which use environmental valuation techniques.⁵ This perhaps reflects a combination of the fact that there are probably less than 13 people in the country researching environmental economics exclusively (including the 9 research postgraduates in my department!) with the anecdotal observation that

there seem to be no environmental economists in the Department of the Environment and Local Government (DOELG) or the Environmental Protection Agency. I doubt there is any other country in the developed world where this is the case. Hence there are few people who understand how useful these techniques are and how sophisticated the techniques have become and virtually no funding for such studies.⁶ This may also explain the reluctance on the part of the Irish authorities to embrace market-based instruments in environmental policy as will be discussed later.

The absence of attempts at substantive non-market valuation is especially unfortunate because as societies get richer, it is precisely the 'non market' aspects of life that become increasingly valued. If there is no systematic attempt to value these aspects, then it is difficult to incorporate systematic debate on these dimensions into the policy process. For example, was it sensible to destroy part of the Glen of the Downs nature reserve in order to widen the N11 or should the road have been built around the reserve? Do the environmental benefits of the Rural Environmental Protection Scheme (REPS) justify the subsidies paid to farmers? Should we be preserving green space in urban areas and what features should it have?⁷ On a positive note, I am glad that the DOELG have recently advertised for an environmental economist and hope that they give their new recruit a large budget for commissioning research!

4. GENUINE SAVINGS AND THE WEAK SUSTAINABILITY TEST

Standard national accounting procedures fail to reflect the deterioration in environmental quality that can result from economic growth e.g. they neglect to reflect the reduction in quality of life in Dublin resulting from increased traffic congestion. Therefore, the accounts do not give a true picture of our well-being. 'Green' accounting endeavours to reflect the value of environmental services in figures of national product. Scott (1999) develops parallel environmental accounts for the Irish economy for 1994. However, Scott's approach does not attempt to provide a single number that could characterise overall performance.

Achieving sustainability, however defined, involves creating and maintaining wealth. Following the pioneering work of Pearce and Atkinson (1993) there have been continuing efforts to expand the concept of net savings and consequent changes in wealth by adjusting conventional measures to include changes in natural resource stocks, changes in health and education, and changes in utility as a result of environmental degradation (Hamilton and Clemens, 1999; Hamilton, 2000). A key underlying assumption of the 'weak sustainability' rule is that forms of capital are substitutes. This implies that a country could run down its natural capital but, if it were investing it in education and health, it could have positive genuine savings, and be judged to be 'sustainable' according to this weak criterion.

Genuine savings (GS) may be defined as: Gross Domestic Product (GDP) less consumption (C), depreciation (Dp), and depletion of natural assets (DI), plus

investment in education (Ed) primary health (H) and research and development (RD) or:

$$GS = GDP - C - Dp - Dl + Ed + H + RD$$

There are difficulties in quantifying some of these adjustments. For example, damage estimates associated with greenhouse gas emissions are used as a proxy for most environmental degradation. A significant weakness with this approach is that it does not (although no alternative does better at this point) net out 'imported sustainability' e.g. if the manufacturing of the goods imported by Singapore results in the country of origin being unsustainable, this is not reflected in Singapore's rating. However, this work still represents considerable progress. The World Bank has published estimates for 100 countries (World Bank, 1997), which indicates that many developing countries fail the weak sustainability test, i.e. their net capital stock is in decline. Expressing these changes in per-capita terms for 1997, we find that Ireland's rapid growth gives it a high positive net savings rate, amounting to US\$5,027. This leaves it ranked third in the world, behind Japan and Singapore (Table 2 below).

The countries that have high rates of genuine savings have some combination of high rates of savings and net investment, and low rates of domestic resource exploitation and environmental degradation. The large negative-savings countries have some combination of large net depletion of natural resources and environmental degradation, and low net savings and investment. Ireland comprehensively passes the 'weak sustainability' test. However, does this mean that all is well?

Table 2: Genuine-Savings Estimates for Selected Countries, 1997.

<i>Top Six Countries</i>	<i>Genuine Savings per capita (US\$)</i>
1. Singapore	8942
2. Japan	7087
3. Ireland	5027
4. Belgium	4419
5. Sweden	4051
6. Germany	4025
<i>Bottom Six Countries</i>	
1. Israel	-4476
2. Saudi Arabia	-3770
3. Australia	-1115
4. Venezuela	-718
5. Guatemala	-572
6. Argentina	-499

Source: Hamilton, 2000.

5. ECONOMIC GROWTH AND INDIVIDUAL ENVIRONMENTAL INDICATORS

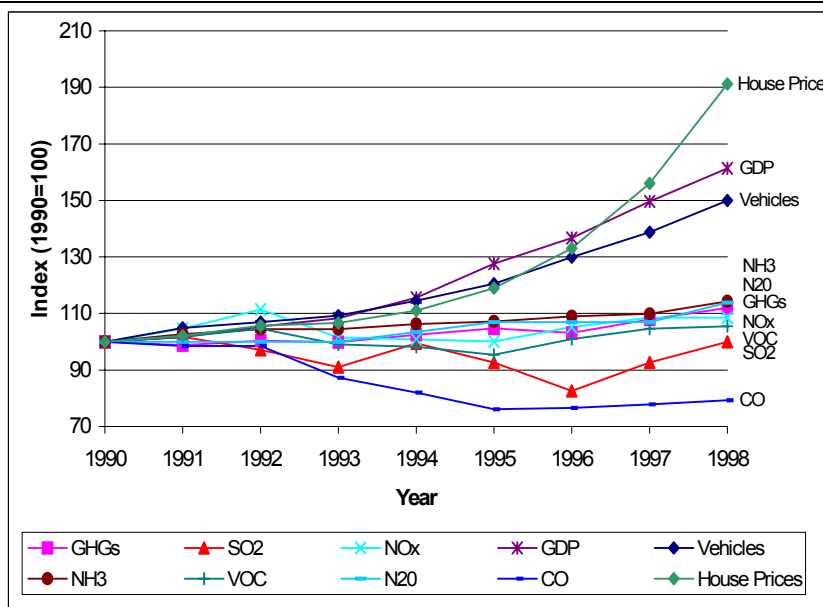
While it is encouraging that Ireland has such positive net real savings, a more nuanced examination as to what is happening gives rise to concern. Rapid growth has engendered activity that can intensify pressure on environmental endowments. The estimates of environmental degradation used in the calculation of net savings exclude the most serious negative effects on quality of life in Ireland. If emissions to air are used as a proxy for environmental performance, Ireland is seen to have a mixed performance. Over the period 1990-1998, emissions of SO₂ stayed relatively constant, and CO was reduced by 21 percent. But emissions of greenhouse gases increased by 13 percent, NO_x emissions increased by 8 percent, VOCs by 6 percent, N₂O by 14 percent. This compares with GDP growth over the same period of 61 percent, so that, while deterioration in an absolute sense is evident in some quarters, the rate of deterioration is much lower than the rate of GDP growth.

However, this calculus ignores impacts of considerable import for the quality of life, and especially perhaps urban living. While incomes have risen, urban dwellers face increased road congestion, longer commuting distances, housing shortages, increased noise etc. Using house prices as a proxy for housing shortages and vehicle numbers as a proxy for congestion, it can be seen from Figure 1 that, unlike emissions to air, these environmental impacts have kept pace with GDP growth. While between 1990 and 1998, GDP increased by 61 percent and the volume of industrial production more than doubled, vehicle numbers increased by 50 percent and house prices increased by 91 percent (they doubled in Dublin). The real rise in house prices has of course given existing (pre-boom) owners a substantial capital gain, but for new entrants at the margin, the incremental costs are substantial. Noise complaints to Dublin Corporation almost doubled between 1996 and 1998. The incidence of levels of Particulate Matter in parts of Dublin is roughly twice recommended levels.

Why this discrepancy in performance? Partly, it lies in what drives environmental policy in Ireland. We find that it is not indigenous concerns about quality, but targets, in the form of assigned amounts or quotas in the case of greenhouse gases and acid precursors, in the form of emission standards in the case of wastewater treatment, or as ambient standards in the case of smoke and sulphur concentrations in the atmosphere.

It is also important to note that these indices only reflect what is happening to our environment today. It may well be that there are activities generated by growth whose malign effects will occur in the future. Take the case of the explosion in one-off housing noted earlier. It is very likely that some of such housing will result in the contamination of groundwater supplies as septic tanks leak or are inadequately managed. However, this contamination may take years to 'show up' in the wells and water supplies of other users of the groundwater reservoir.

Figure 1: Indexes of GDP, Vehicle Numbers and Selected Air Emissions, 1990-1998.



6. ENVIRONMENTAL POLICY 'DRIVERS'

International and European Union

In addressing the environmental challenges generated in the main by economic growth, Irish policymakers face a number of constraints. First, in a series of European Union Directives and Regulations, they are obliged to meet legal obligations concerning a wide and growing range of issues, including: emission standards for waste water; ambient air and water standards; standards for drinking water; quantified targets for recycling and re-use of packaging; requirements for provision of environmental performance information; identification and protection of a network of Special Areas of Conservation (SACs) comprising habitats for flora and fauna that are of Europe-wide significance. Provisions in the Amsterdam Treaty allow the European Court of Justice to impose large fines on Member States who are judged to be in non-compliance, so that the potential costs are real.

Secondly, at global and European regional level, there are commitments not to exceed assigned amounts of greenhouse gases (Kyoto Protocol), to phase out the production and use of stratospheric ozone depleting CFCs (Montreal Protocol), and limits on emissions of acidification precursors (Gothenburg Protocol).

The Domestic Economy-Environment Interface

Firstly, there is a direct negative feedback loop to the economy as regards environmental degradation. For the rapidly growing tourist industry, a high-quality environment, and heritage buildings and associated cultural endowments, are key assets. For the food industry, a high-quality environment is important for the image of the product in international markets. For the information technology and financial service industries, a high quality of life, including a good environment, is an important attraction for some high, and relatively scarce, skilled workers and entrepreneurial talents.

Secondly, there is the pressure from Irish residents for a local high-quality environment. This is expressed most forcefully in the development of avoidance strategies concerning the location of landfill and incineration, but tends to be relatively weak as a source of pressure in relation to strategic national and regional issues such as congestion and settlement.

The Policy Process

Key actors shaping environmental performance are the following:

The *Department of Finance* has lead responsibility for the preparation and execution of the National Development Plan, for fiscal policy, and for controlling expenditure. It leads an interdepartmental group that reviews the fiscal situation and the potential for the application of fiscal measures to advance environmental objectives. It produces periodic reports.

The *Department of Environment and Local Government* has lead policy responsibility for: housing, water and air, waste, and for the planning system. It allocates funding to local authorities for housing, local roads, water supply and wastewater treatment, and waste disposal. The Department led the preparation of a National Sustainability Strategy in 1997. It leads a 'Green Network of Government Departments' that comprises a network of Assistant Secretaries in departments with significant environmental impact. They aim to integrate environmental considerations into economic development. Eco-auditing is regarded as a key element in the attainment of such integration.

The *Department of Arts, Heritage, Islands and the Gaeltacht* has the lead policy responsibility for conservation of the built and natural environment, including habitats, wildlife, National Parks and Monuments.

The key sectoral departments, *Agriculture and Food, Enterprise, Trade and Employment* (industry), *Marine and Natural Resources* (freshwater and marine fisheries, forestry), *Public Enterprise* (energy), *Tourism Sport and Recreation*, have units addressed to the environmental aspects of their activities.

There are a number of government agencies and bodies with responsibilities for aspects of environmental performance. The *Environmental Protection Agency* is an independent organisation with responsibilities for licensing of industry [Integrated Pollution Control (IPC) licensing], environmental monitoring (including production of state of the environment reports), research, and overview and support of the local authorities in the implementation of their responsibilities. The *Heritage Council* has responsibility for promoting conservation of the heritage endowment; *ENFO* has the lead responsibility for promoting public awareness of environmental issues and performance; the *Irish Energy Centre* has an information role in promoting energy conservation.

Policy as regards housing, water supply, wastewater treatment, solid waste and land use are implemented by the *local authorities*, from whom permission must be sought for most industrial, residential and commercial development. Decisions by the local authorities are based on the provisions of the Development Plan for the area for which they have jurisdiction, and any policy guidance by the Minister for Environment and Local Government. The decision can be appealed by the proposer or by any third party to a national appeals authority (*An Bord Pleanála*) whose decision is final.

There are a number of non-governmental environmental organisations, including *An Taisce*, the National Trust for Ireland. Under the planning regulations, this organisation receives planning applications likely to be of significant environmental importance.

7. POLICY RESPONSES

There are two main policy responses. The first is a set of investment programmes presented in the National Development Plan. The second is the use of regulations and licensing and other policy instruments to shape performance.

The National Development Plan 2000-2006

The National Development Plan identifies the key government programmes to be implemented over the seven-year period. Specifically, it comprises the template that will shape how and for what purposes public funds will be expended, and is the basis for the request for Community Structural and Cohesion Fund support. It comprises a problem analysis, to which the National Plan provides the solution. It can be seen below that the main investments relevant to relief of congestion are the proposed expenditure on public transport in Dublin, driven mainly by the economic necessity to limit gridlock and meet public frustrations regarding congestion, and the investment in water and waste water, driven mainly by the need to meet requirements in regard to both drinking water and waste-water emissions.

Table 3: Some Key Elements in the National Development Plan, 2000-2006

<i>Environmentally relevant element</i>	<i>Amount (€ millions)</i>	<i>Main features</i>
National roads	7,578	Bringing key national routes up to motorway standard.
Public transport – greater Dublin	2,555	Provision of light rail, suburban rail, quality bus lanes and rolling stock
Regional Public Transport	1,048	Improvements in safety, physical capacity and quality and reliability of national rail system.
Water and waste water	3,168	Bring the wastewater emissions from the 155 urban agglomerations each with a population equivalent of at least 2000 into compliance with the Urban Wastewater Directive. Bring the quality of drinking water up to standards of the Drinking Water Directive, and invest in water conservation. Provide catchment protection, including monitoring of effectiveness of wastewater treatment capacity.
Coastal erosion	44	Provide environmentally sensitive protection in the case of particular cases of erosion, including research
Solid Waste	825	Rationalise municipal waste landfills, leading to integrated network of some 20 state-of-the-art facilities. Develop waste recovery including development of composting.
Energy	185	Promotion of alternative energy, and energy efficiency
Agriculture – Rural Environmental Protection Scheme	1,905 (includes annual payments)	Conservation, protection of habitats and water courses
Agriculture – Waste management	187	Improved animal housing, and farm waste storage
Forestry	736 (includes annual premia)	20,000 hectares per annum to be planted; investment in roads and woodland improvement
Environmental Research	25	Measuring impact of economic development, demonstrations of best practise, development of systems, models, instruments and techniques to assist policy and decision-making.
Total	18,256	

Source: Government of Ireland (1999).

Policy Instruments

A striking feature about environmental policy in Ireland is the very limited range of policy instruments employed (Table 3). There is a heavy dependence on regulations and exhortation to achieve objectives, with an emphasis on subsidies in the case of farming.

Economic instruments are employed only in regard to energy use in transport, and then, with the notable exception of the excise duty differential favouring unleaded petrol, only as a by-product of revenue raising. Systematic information on environmental performance, in the sense of the toxics release inventory in the US, as a matter of routine, is not part of the policy process. There are only two voluntary agreements in operation, both relating to packaging waste. Nevertheless, a range of policy instruments are mobilised to address environmental challenges, examples of which are presented in Table 4. There is virtually no research in environmental economics and policy analysis funded by the State that would inform choices in regard to either instrument selection or implementation.

Table 4: Policy Instruments: Examples of their Use in Environmental Policy.

<i>Policy Instrument</i>	<i>Example</i>
Information on environmental performance	State of the Environment report
Regulation (command and control). Limits on pollution are set, enforceable in a court of law	Integrated pollution license for most industry with polluting potential
Removal of environmentally damaging subsidies	'Capping' of ewe premia and headage payments for sheep, to reduce grazing pressure on upland commonages
Grants and cash subsidies to improve environmental performance	Cost-sharing grants to farmers to provide increased storage capacity for farmyard manure
Tax incentives to encourage environmentally useful behaviour	These have been provided to encourage the relocation of development activity into deprived inner cities and towns
Voluntary agreements to meet environmental objectives	Most of those involved in the packaging industry in Ireland have combined in a voluntary agreement ('REPAK') to meet recycling and re-use targets. Plastics packaging used in farming ('farm film') is also recycled via a voluntary agreement.
Taxes and charges on emissions to the environment	Some local authorities charge for emissions to wastewater plants based on magnitude of pollution loading.
Emissions trading, whereby a quota of emissions is fixed and allocated amongst polluters, who can then buy and sell them	none

In what follows, short summaries of the key environmental challenges facing Ireland are provided, the existing policy responses and their likely adequacy are noted and a comment on any additional policies recommended included, with an emphasis on the mobilisation of market forces in this regard. In Table 5, the menu of issues to be addresses is listed.

8. ENVIRONMENTAL POLICY ISSUES

Environmental policy issues faced by Ireland can be characterised on the basis of meeting objectives in regard to air, water, climate change, etc., and on the basis of sectoral performance. This paper address the issues from both perspectives. This involves some duplication of data and themes, but it is worthwhile because there are distinct policy drivers and audiences for both category types. The key issues are summarised in Table 5, and each is considered in turn for a more detailed treatment.

ENVIRONMENTAL ISSUE 1: GREENHOUSE GAS EMISSIONS

Performance

The high and positive correlation between GDP and energy use has resulted in a rapid rise in greenhouse gas emissions over the past 10 years:

- Most of this growth has occurred since the 1990 base year for the calculation of emissions under the Kyoto Protocol.
- Such unprecedented growth has resulted in estimates that, under a ‘business as usual’ scenario, total emissions would increase by between 37 percent and 41 percent.
- The transport and residential sectors would account for over 44 percent and 20 percent of this increase respectively with the share of emissions produced by the transport sector rising rapidly and the proportionate share accounted for by agriculture and the residential sector falling (Table 6).
- Thus, despite being allowed a 13 percent increase in emissions due to its status as a ‘cohesion country’, Ireland will exceed its Kyoto target (of 60.74 million tonnes of CO₂-equivalent) by between 13 and 14.4 million tonnes if business as usual persists (Table 7, Figure 2).

Response

No effective action as yet apart from an ambitious forestry programme (Department of Agriculture, Food and Forestry, 1996) to double the forest area was announced in 1996. This involves planting 20,000 to 25,000 hectares per annum up to 2030. Although the primary goal of this programme is to develop a sustainable wood supply and processing industry, under the provisions of the Kyoto protocol, CO₂ ‘sequestered’ by forests established since 1990 is allowed as a deduction to the overall target. This sequestration is included in the figures above.

Table 5: Key Environment-Development Issues, Performance and Policy Responses.

<i>Environmental Issue</i>	<i>Performance</i>	<i>Existing Primary Policy Response</i>
1. Meeting Kyoto greenhouse gas emissions target	Under business as usual, The 61 million tonne CO ₂ -equivalent target will be substantially exceeded	Climate strategy document prepared, but no effective action yet. Discussion by Minister for Environment of mobilising taxes to this end; objection to EU 'Energy Products tax' proposals have been withdrawn
2. Meeting Acidification precursor targets as agreed under the CLRTAP and Gothenburg Protocol and Meeting prospective standards for ambient concentrations of NO _x and PM _{10s}	Stabilising of SO ₂ emissions; nevertheless, under 'business as usual' projections, there will be substantial overshooting of targets agreed for SO ₂ (by 136 thousand tonnes), NO _x (by 60 thousand tonnes) and VOC (by 55 thousand tonnes). Downward trend in ambient air quality in cities, especially regarding PM ₁₀ and NO _x . Levels in excess of likely limits in forthcoming Directive	No action as yet on acidification precursors Investment in bypasses around most urban areas, and the development of mass transit infrastructure in Dublin (light rail, dedicated bus lanes, cycle lanes and pedestrianisation). Improvement in emissions per km travelled due to EU emission standards for new cars. Vehicle testing, introduced in 2000, will also help set minimum emission standards for old fleet.
3. Meeting water quality objectives in Irish and EU legislation	Downward trends in freshwater water quality. Major non compliance with EU drinking water Directive, and prospective non compliance with Water Framework Directive as regards no deterioration.	Pilot projects in river basin management; regulations specifying minimum standards in freshwater; grant schemes to support installation of nutrient storage on farms; integrated pollution control (IPC) licensing for most industry; EU supported investment in wastewater treatment capacity, driven by the Urban Wastewater Directive

4. Stabilising waste emissions (hazardous and non hazardous)	All categories – agricultural, manufacturing, mining and quarrying, hazardous, municipal, construction and demolition, drinking water sludges – increased over the 1995-'98 period	Some investment in modern landfill capacity; voluntary agreement re packaging waste beginning to have some effect. Charging industry, commercial based on weight beginning, but not applied to municipal. Expansion in number of recycling drop centres. Landfill/plastic bag taxes proposed.
5. Settlement and Meeting rapidly growing accommodation needs	The dynamic economy, back migration combined with natural growth in population has resulted in rapid growth in the demand and for housing. Although annual supply has increased from approx. 20,000 to 50,000 units over the past 5 years, prices have continued to escalate and this is adding to wage and associated inflation pressures. Settlement is spreading out in low density suburbs	Grants to increase supply of serviced land, proposals to speed up decisions on planning and development proposals, draft legislation to require up to 20 percent of privately developed housing to be made available for social (public) housing, and to encourage more dense development along public transport corridors.
<i>Sectoral Issues</i>		
1. Transport	The growth in disposable income and population has led to a doubling of car numbers, and this in turn has resulted in serious congestion costs and increased emissions of NO _x and PM _{10s}	Grants to dispose of cars > 10 years old (the 'scrappage' scheme), investment initiated in light rail (Dublin only), commuter rail, bus lanes, cycle lanes and pedestrianisation. No use of congestion charges. Virtually all on-street parking in Dublin city-centre is charged.

2. Energy	Final demand for energy continues to grow in line with GDP growth, and under 'business as usual' this is expected to continue across all consuming sectors, with growth especially pronounced in transport and households.	Good information programmes on energy conservation, some support for combined heat and power and renewables, higher house insulation standards mandated for all houses built post 1997, but otherwise few demand management efforts
3. Agriculture and Forestry	Key challenges are emissions of acid precursors (ammonia), eutrophication of freshwater, nitrification of groundwater, and biodiversity loss. Global warming also an issue.	Good information programme on eutrophication for farmers, some regulatory control in a few sensitive catchments, subsidies for animal waste storage, and for a range of environmental measures under the Rural Environmental Protection Scheme (REPS), which is a voluntary programme. Annual payments being made to farmers owning Special Areas of Conservation (SACs) under the Habitat protection scheme. No use of market based policies. Expansion of afforestation will give rise to landscape and habitat issues, but 'code of practise' and mandatory guidelines on various environmental dimensions are in train.
4. Tourism	Dramatic growth in visitor numbers leading to increase in access transport externalities, congestion, loss of character, and pressure for development of golf courses, hotels, and other tourist related facilities.	Control of development left to local authorities that suffer from diseconomies of scale in expertise and potential local pressures in making and enforcing decisions. A series of pilot schemes designed to demonstrate integration of environment and tourism have been initiated.
5. Industry	Rapid growth in industrial output has increased pollution potential, but nature of industry is relatively 'clean' and controlled.	The Integrated Pollution Control (IPC) licensing process now 'picks up' all new, and most existing industry with polluting potential. No use of market instruments.

However, the afforestation rate is running at about 50 percent of the target. If this were to be continued, the 2010 'High' scenario would apply under business as usual.

If the full planting target is achieved, the 'Low' business as usual scenario would apply. However, the figures for sequestration involve a 'back of the envelope' procedure and there is some evidence that soil disturbance during forest establishment on some sites (particularly on peat soils) could result in net emissions of greenhouse gases. A further issue in regard to the use of afforestation as a sink is the assumption in the figures that the majority of trees planted will be non-indigenous conifers. These trees grow rapidly in the Irish climate and therefore are ideal for sequestration. However, their effect on the environment is a controversial matter and Irish environmental NGOs have had some success in holding up EU funding on the basis that more broadleaves should be planted. If more broadleaves are planted, the rate of sequestration over the 2000-2012 period (the 'first commitment period' of the Kyoto Protocol) will be reduced.

Table 6: Breakdown of Greenhouse Gas Emissions by Sector, 1990 and 2010

<i>Sector</i>	<i>Proportion of Total Emissions 1990 (%)</i>	<i>Proportion of Total Emissions 2010 (%)</i>
Agriculture	34.6	25.6
Energy	21.6	25.0
Residential	13.1	9.0
Transport	9.5	18.9
Industrial	8.0	8.0
Process	5.4	6.6
Commercial/Institutional	4.5	5.4
Waste	3.3	1.5

Source: Consultation Group on Greenhouse Gas Emissions Trading (2000).

The Minister for the Environment and Local Government established a consultation group on greenhouse gas emissions trading to advise on options for trading both in Ireland and in the context of international agreements. The Group reported in July 2000 and concluded that emissions trading should be used to the maximum extent, that the Government should oppose a 'concrete ceiling' that would place a limit on the proportion of emission entitlements that can be traded and that Ireland should also participate in the Joint Implementation and Clean Development Mechanisms. The Group set out principles for a domestic emissions trading system and recommended that the Irish Government support the development of an international emissions trading scheme and that Ireland be a participant.

The Department of the Environment and Local Government (2000a) has produced a national climate change strategy. This includes a number of proposed initiatives to eliminate the overshoot including: that, in addition to the removal of subsidies supporting inefficient use of energy, a framework for greenhouse gas taxation be put place from 2002 with the revenue recycled to reduce direct taxes, labour taxes and to

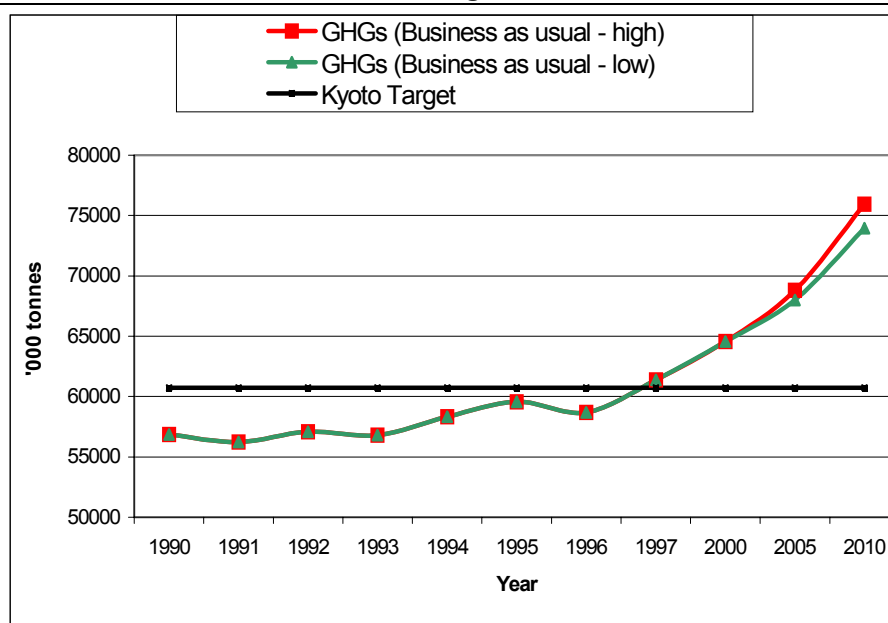
support energy-efficiency measures, R&D and information and education programmes with partial tax-rebates for industries sensitive to external competition.

Table 7: Greenhouse Gas Emissions by Type, Million Tonnes of CO₂-Equivalent.

	CO ₂	CH ₄	N ₂ O	HFC, PFC, SF ₆	Total Emissions
Base year	31.575	12.836	9.085	0.256	53.752
1998 (provisional)	40.028	13.631	10.069	0.256	63.984
2010 (Low)	51.373	12.185	9.720	0.672	73.950
2010 (High)	51.373	12.185	9.720	1.885	75.163
Kyoto Target					60.74
Overshoot (low)					13.210
Overshoot (high)					14.423

Source: 2010 projections based on official projections provided by Government Departments to EPA.

Figure 2: Business as Usual Greenhouse Gas Emissions, 1990-2010, and associated Target for 2012.



The tax will be levied both upstream and downstream, the latter applying particularly in the case of electricity consumption. No initial rate has been set but it will be varied annually to improve its effectiveness. Industries will be able to qualify for

reductions in the tax rate subject to negotiated agreements. This potential for agreements will be explored during negotiations over tax rates. The tax will be reviewed in the context of the development of emissions trading regimes. The sectoral initiatives are set out in the relevant sections in this paper and the sectoral targets are listed in Table 8.

The Future

While the rate of growth of GDP has been higher than many expected in the interim, it has been clear ever since Ireland signed the Kyoto Protocol that the country faces severe difficulties in meeting the set target. Despite this, there have been virtually no significant measures implemented and despite the observation that the Bush administration will refuse to sign the Kyoto Protocol, the EU will push forward with the burden sharing agreement.

Table 8: Targets of Draft Greenhouse Gas Abatement Strategy.

<i>Reduction Source</i>	<i>Reduction in GHGs (mt)</i>	<i>Proportion of overshoot</i>
Energy	- 6.35	44%
Industry	- 2.0	14%
Agriculture	- 2.26	16%
Residential	- 0.6	4%
Transport	- 2.67	19%
Landfill and thermal treatment	- 0.8	6%
Business as usual overshoot	+ 14.423*	
Overshoot with Strategy 2010	- 0.257	

**Assuming 50 percent of current forestry target achieved.*

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

It is interesting to note that Ireland opposed the development of a European carbon tax despite the fact that such a flexible mechanism would reduce the cost of emissions reductions. However, in the strategy, there is, at last, some recognition that fiscal incentives are required in order to make a significant reduction in the overshoot and support for an EU-wide trading system. While this 'conversion' to least-cost mechanisms is to be welcomed, research on the appropriate structure and magnitude of a carbon/energy tax is sadly lacking. This leaves the field open to the interest groups such as IBEC (the employers group) who have produced a report which, to say the least, does not present such a tax in a favourable light. The Government has not carried out research, which can verify, for example, the elasticity figures in the report.

Under the social partnership arrangements, the Government will have to persuade IBEC and others to support the tax. IBEC favours voluntary agreements. The unions, stung by the recently negotiated pay increases being eroded by inflation, called for reductions in excise duties in order to reduce inflation and were rewarded in the last budget when duty on petrol was reduced. It remains to be seen if, in the light of this, any agreement can be reached on energy taxation. A lot will depend

upon the inflation rate and oil prices. If inflation stabilises, then environmental tax reform will be considerably easier. If oil prices fall, it will make it easier to increase taxes on fuel. However, the effect of such a tax would be lessened.

ENVIRONMENTAL ISSUE 2: EMISSIONS OF ACIDIFYING GASES, OZONE PRECURSORS AND PARTICULATE MATTER

Performance

Sulphur Dioxide (SO₂), Nitrogen Oxides (NO_x), and Ammonia (NH₃) can result in the acidification of soils and surface waters and nitrogen saturation in terrestrial ecosystems. NO_x and Volatile Organic Compounds (VOCs) can have detrimental effects on vegetation and human health (Stapleton *et al.*, 2000). The principal negative effects of Particulate Matter are on human mortality and morbidity, mainly via infections in the respiratory tract. Currently, the emphasis is placed on PM₁₀ as their small size allows easier diffusion into the lungs and respiratory system.

Although there was a decrease in the first half of the decade, emissions of SO₂, NO_x, VOCs and CO increased again during the late 1990s due to an increase in consumption of primary fuels. According to Stapleton *et al.* (2000), the variation in NO_x (Figure 3) emissions over the decade is the result of a programme to retrofit some of the largest power stations with NO_x control technologies which led to some units being off-line for long periods.

Given the rapid rate of growth in the economy, this performance could be said to be quite satisfactory. However, in relation to SO₂ emissions (60 percent of which come from power stations), much of the offset has resulted from the move to low-sulphur coal and gas-fired plants and while Ireland's emissions have remained steady, emissions in other European countries are generally falling.

Emissions from transport comprise over 50 percent of emissions of NO_x and VOCs. Regulations regarding catalytic converters have offset the increase in vehicle numbers.

Ammonia emissions have increased in line with trends in livestock numbers, with fertiliser use increasing from 112,000 tonnes in 1990 to 126,000 tonnes in 1998; agriculture is responsible for almost all of these emissions (Stapleton *et al.*, 2000).

Ireland failed to meet the targets of 105,000 tonnes of NO_x in 1994 (actual was 115,600 tonnes) set by the Sofia Protocol (1988).

Ireland has almost certainly failed to meet the target of 157,000 tonnes of SO₂ in 2000 (actual in 1998 was 176,000 tonnes) set by the Oslo Protocol (1994).

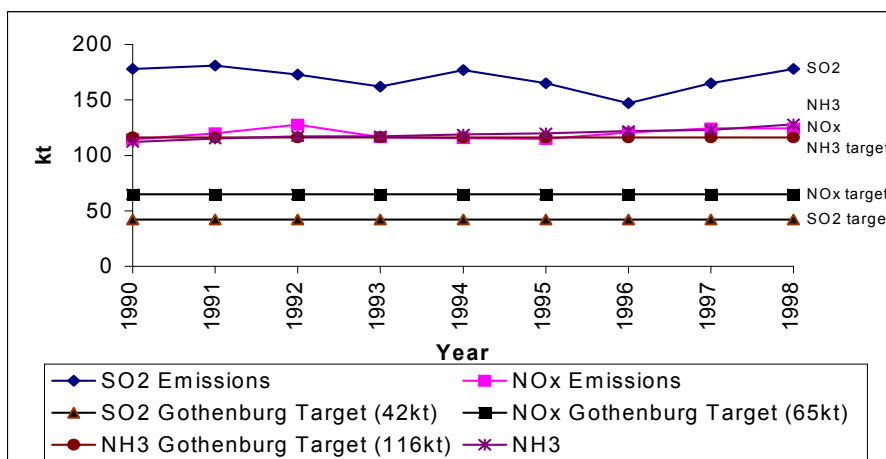
Under the recently signed Gothenburg Protocol (1999) (and, most likely, the forthcoming EU Directive), Ireland is committed to reducing SO₂, NO_x, NH₃ and VOC emissions to 42,000 tonnes (from 176,000), 65,000 tonnes (from 124,000), 116,000 tonnes (from 128,000) and 55,000 tonnes (from 115,000) respectively by 2010.

Measurement of particulate matter emissions began in Dublin in 1996 and, since then, emissions have remained relatively constant. The measurements show that, in a representative area (Merchant's Quay) over 20 percent of days have a concentration of PM₁₀ greater than 50 ug/m³. The annual mean is about 40 (Stapleton *et al.*, 2000).

Response

None.

Figure 3: Emissions of SO₂, NO_x, and NH₃, 1990-1998, and Associated Targets for 2010.



Source: Derived from McGettigan and Duffy (2000).

The Future

The Gothenburg Protocol negotiations employed the use of a computer program called the RAINS Model to assisted in identifying a cost-minimising strategy for abatement across Europe and thereby specified emissions ceilings for UNECE countries. Ireland was allocated relatively strict emissions limits. This is because, heretofore, there have been very few initiatives to reduce acidification precursors so Ireland is relatively far down the marginal abatement cost curves for the various pollutants. Given the prevailing winds, the benefits to Ireland of the "G5/2" negotiation scenario were less than the costs of achieving the targets. Indeed,

Ireland was the only loser from the original scenario. The outcome of the negotiations was that Ireland achieved a relaxation of the SO₂ and NO_x ceilings from 36kt to 42kt and from 55kt to 65kt respectively. The increase in the SO₂ ceiling is thought to have reduced compliance costs for the electricity generation sector considerably. Nevertheless, reductions of 76 percent in SO₂ and 48 percent in NO_x will be required by 2010 given that the Gothenburg ceilings are likely to be reflected in the forthcoming EU Directive. These reductions will be expensive to achieve. The VOC target of 55kt (a 50 percent reduction) reflects the EU Directive on VOCs.

Some of the initiatives for reducing greenhouse gases are complementary to efforts to reduce acidification precursors, such as the closure of Moneypoint power station by 2008. Interestingly, the Kyoto Protocol has received much greater attention than has Gothenburg. While there has not been a dramatic increase in the pollutants covered by Gothenburg, they have not reduced significantly and large reductions are required. It would seem wise to develop an integrated strategy to address both issues together. Otherwise, Ireland seems likely to fail to live up to its commitments to Gothenburg as it has failed to under the Sofia and Oslo Protocols. However, unlike these cases, failure to meet the forthcoming Directive will prove costly to the State.

Council Directive 1999/30/EC, which provides a basis for the Framework Directive on air quality assessment and management, has set limits on the concentrations of various air-borne pollutants. While the mean exposure to a concentration of PM₁₀ greater than 50 ug/m³ is within the limits set in the Directive, such exposure occurs on twice as many days in Dublin as the set limit (35 days) (Stapleton *et al.*, 2000). Therefore, even if the expansion in vehicle numbers and increases in congestion (see Transport section) do not have a significant impact on particulate matter concentrations in Dublin, the concentration levels are in excess of the limits in the forthcoming EU Directive. The Directive will also cover the health effects of concentrations of SO₂ and Nitrogen Dioxide (NO₂), however, concentrations at monitoring stations are in compliance with the limits, albeit only just.

While emissions of most of these pollutants from industry are covered by Integrated Pollution Control licensing, there seem to be no plans to introduce any economic instruments such as sulphur and NO_x charges.

ENVIRONMENTAL ISSUE 3: FRESH WATER QUALITY

Performance

An early problem of water quality in Ireland was dramatic fish kills, a consequence of highly toxic run-off from the making of silage (fermented grass) to feed livestock. That problem has been successfully addressed by providing proper storage and by enforcing the law. The core issue today as regards water quality is the continuing secular decline in the length of unpolluted rivers, and continuing deterioration in lake quality due to eutrophication, i.e. enrichment of the river systems. This is a

consequence of nutrients running off into freshwater systems, which stimulate the growth of algae. This in turn reduces visibility for fish, reduces oxygen levels in water, and clogs up spawning beds and inhibits breeding. For most it is also aesthetically displeasing. The performance is summarised in Table 9.

Table 9: Quality Status of Freshwater Rivers in Ireland, 1987-1997, As % of Total

River Quality	1987-90	1995-'97
Unpolluted	77.3	66.9
Slightly polluted	12	18.2
Moderately	9.7	14
Heavily polluted	0.9	0.9

Source: EPA (1999)

The percentage of unpolluted river, at 66.9 percent, is very high in a European context, but the rate of deterioration is alarming - more than a 10 percent fall in less than 10 years. Nitrate concentrations have increased markedly in a number of rivers over the 1982-1998 period, including the Shannon, the Suir and the Blackwater. Sewage is the dominant cause of the heavily polluted stretches (48 percent), but agriculture and industry are also major contributors (Table 10). Agriculture is the dominant source of the moderate and slightly polluted problems, followed by sewage.

Table 10: Pollution in Irish Waterways by Severity and Source of Pollution, 1995-1997.

Source	Slightly polluted		Moderately polluted		Heavily polluted	
	No.	% of total	No.	% of total	No.	% of total
Agriculture	274	47	276	46	16	25
Sewage	137	24	150	25	31	48
Industry	50	9	14	22	14	22
Other	119	21	4	6	4	6
Total	580	100	65	100	65	100

Source: EPA (1999, p. 10).

The negative consequences of this deterioration for well-being have never been systematically evaluated, but the external costs include the following:

- Loss in the quality and extent of the fishing experience for Irish residents;
- Loss of revenues and employment deriving from the growing tourist fishery;
- Reduction in species biodiversity, and potential non-compliance with the Habitats Directive;
- Damage to Ireland's image as 'clean and green', which has some economic significance in contributing to loss of positive self-image in Ireland, and potential loss of comparative advantage in marketing food and tourism;
- Additional costs of treating drinking water from surface sources.

A number of actions have been taken:

- The food and pharmaceutical industries, which are the principal sources of organic waste emissions to water, have been incorporated into the Integrated Pollution Control (IPC) system operated by the EPA. This should have reduced emissions from these sources.
- There has been substantial investment in municipal wastewater treatment plants that emit into fresh water. Some of this is driven by the need to meet the objectives of the urban wastewater Directive. This should reduce emissions from this source. However, the imperatives of the Directive have concentrated the bulk of the new investment in coastal cities at marine outfalls; it may be that there will be under-investment in wastewater treatment at inland freshwater sites, where problems are most acute.
- There has been substantial investment in farmyard-pollution reduction, specifically, the grant scheme for the storage of farmyard manure, but also including investment under the Rural Environmental Protection Scheme (REPS).
- Regulations have been enacted setting minimum standards for various qualities of water. These have the effect of requiring reduction in pollution in catchments and reaches that are above the minimum acceptable standard, and the maintaining of high quality where it still exists.
- A number of pilot schemes have tested the utility and optimum mechanisms for implementing catchment-based planning and decision-making.
- A number of local authorities are charging for the use of wastewater treatment capacity based on the toxicity and costs imposed on the system.
- A nutrient testing service has been developed and operated by Teagasc, and competing organisations. This will determine the extent to which soils are already saturated and the extent to which further application of artificial or organic fertiliser will simply run off rather than be incorporated into the soil and growing matter.

Given the extent of the investment and other actions, it is surprising that the trend in quality is still downward. This raises questions concerning the effectiveness of such investment and other actions in achieving improvement, but it is also true that much of the new treatment capacity remains to be installed and made operational.

The Future

Key issues for the future will include:

- Maintaining the effectiveness of the expensive wastewater treatment plant now in place. The additional energy, chemicals and labour costs are substantial. Since domestic consumers do not pay for water, the burden is carried by industry and commercial users. There is a danger that revenues will not be sufficient to cover operating costs, and some local authorities may be forced to operate the plant below optimum level, thereby damaging performance.

- Implementing the provisions of the European Union Framework Directive as regards minimum standards (the Irish regulations anticipate this to some extent) and implementing the provisions requiring river basin planning and cost recovery. Irish policy is very input focused at present, with the emphasis on investment achieved in various programmes, rather than on the benefits achieved thereby. River basin planning turns the attention on outputs, and provides a forum for getting the key polluters and those most affected around a table to assess the situation and their contribution thereto, and a means of identifying the least-cost solutions to the water quality challenge being faced.

Box 1. Some Provisions of the Draft EU Water Framework Directive

- | |
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| <ul style="list-style-type: none"> • requires economic analysis of water use • investment and forecasts • measures to implement water charging, • measures to meet environmental quality standards • control over abstraction • prohibition on direct discharge, • assessment of ecological status, • actions to maintain status ('good') or 'improve' in the case of below standard waters, • demographic pressures, • sources of pollution, • economic information on abstraction • register of protected areas • plans and actions for the meeting of protected area objectives. |
|--|

- Charging domestic users of water: Ireland is rather unique in a developed country context in that householders do not pay for supplies of municipal water directly. This is a product of public resistance to the annual water charges per household in parts of Dublin, on the basis that it is 'double taxation.' The charges imposed on householders before they were abolished were fixed charges, and so had no effect on household decisions regarding water use. The cost-recovery provisions in the EU Commission's Draft Water Framework Directive are being opposed by the Irish government, because of the perceived popular resistance thereto by householders. If meters were installed, and households were charged for water based on their use, this would greatly enhance the capacity for rational management of an expensive and increasingly scarce resource. However, on September 6, 2000, the European Parliament cleared a derogation from any obligation to introduce water charges in Ireland despite the best efforts of the European Commission.

ENVIRONMENTAL ISSUE 4: SOLID WASTE EMISSIONS

Performance

There has been rapid growth in waste generation over the past five years. All the categories show growth except dredge spoils. Some of this growth is not 'real' as it is based on better reporting, but the Stapleton *et al.* (2000) notes that "*Where historical data is considered to be reasonably reliable, waste quantities appear to be increasing more or less in line with economic growth*". Some specific findings:

- Municipal (households and commercial) only account for 13.4 percent of the total (excluding agriculture) in 1998, and 5 percent of the growth over the 1995-'98 period.
- Household waste arising per person has fallen from 0.38 tonnes in 1995 to 0.33 tonnes in 1998, but the recovery rate fell from 4.3 percent to 3.2 percent over the same period.
- The recovery rate overall is 26.6 percent, with the leading recovery sectors being end of life vehicles (96.0 percent), hazardous wastes (54.4 percent), manufacturing industry (51.4 percent), and construction waste (43.3 percent) recovered.
- The chemical industry dominates the generation of hazardous wastes accounting for 89 percent of emissions arising in 1998.
- The food, drink and tobacco sector dominates the generation of wastes in manufacturing industry, with its 2.4 million tonnes accounting for 46 percent of arising (excluding mining and electricity, gas and water supply).
- Of the best estimate of 296 thousand tonnes of hazardous waste arising, which includes non industrial waste, 74 thousand tonnes, or 25 percent of the total, is unreported, while 100 thousand tonnes, 34 percent of the total, are exported.
- Packaging waste generated in 1998 amounts to 683 thousand tonnes, of which 101 thousand is recovered, 21 percent from the commercial stream and 5.6 percent from the household stream.

Response

The national policy is set out in a *Policy Statement on Waste Management* by the Minister for the Environment and Local Government, released on 1st October, 1998. The basic thrust of the policy is to reduce national dependence on landfill, and to aid local authorities make the transition to an integrated system, developed in a regional context. Specific targets are: diverting 50 percent of overall household waste away from landfill; minimum reduction of 65 percent in biodegradable waste going to landfill; development of waste recovery facilities, including the development of composting; recycling of 35 percent of municipal waste; recycling of construction waste to reach 85 percent over 15 years; rationalisation of landfills, with closure and reduction in overall numbers, leading to an integrated network of some 20 state of the art facilities incorporating energy recovery and high standards of environmental protection.

A number of regional waste management strategies and follow-on plans have been prepared, and now approved by the relevant local authorities, or are under consideration. Proposals for waste incineration (thermal plants) and the 20 landfill sites have been among the most controversial elements in these plans. As regards incineration, key concerns relate to the emissions of dioxins to air, and the disposal of ash to landfill with potential heavy metal contamination of groundwater. With regard to landfill proposals, local opposition focuses on traffic and associated congestion, image problems, groundwater contamination, while at a national level, methane emissions (a greenhouse gas) are a concern. It is national policy that methane emissions from the new landfill sites be reduced by 80 percent.

Table 11: Waste arising in Ireland, 1995 and 1998, in millions of tonnes.

<i>Waste Category</i>	<i>1995</i>	<i>1998</i>	<i>Change 1995-'98</i>	<i>Annual average change</i>	<i>Recovery 1998 (%)</i>
Agricultural	31.00	64.58	33.58	11.19	na
Manufacturing	3.54	4.88	1.34	0.45	51.4
Energy Gas and Water Supply	0.35	0.45	0.1	0.033	16.0
Mining and Quarrying	2.2	3.51	1.29	0.43	0.4
Hazardous Waste	0.24	0.37	0.13	0.043	54.4
Municipal Waste	1.85	2.06	0.21	0.07	8.6
End-of-life vehicles /scrap metal	0.052	0.187	0.135	0.045	96.6
Construction and Demolition Waste	1.32	2.70	1.38	0.46	43.3
Urban wastewater sludges	0.85	0.51	-0.34	-0.11	5.9
Drinking water sludges	0.039	0.058	0.019	0.006	0.0
Dredge Spoils	0.78	0.73	-0.05	-0.017	
Total excl. agriculture	11.25	15.41	4.16	1.40	26.6
Total incl. agriculture	42.25	80.01	37.76	12.59	

Source: EPA (2000, p. 23).

The Future

It is difficult to envisage that the volume of waste going to land fill and incineration can be stabilised or reduced without the introduction of strong financial incentives for the key actors to move in this direction. In the Waste Management (Amendment) Bill 2001, the Minister for the Environment and Local Government has proposed a landfill tax, which will progressively increase annually to an as yet undetermined level and a tax of 15p on plastic bags. Both measures are expected to be introduced in early 2002 (McDonald, 2001).

Dublin Corporation are in the process of introducing 3 wheelie bins for various sorts of household waste and collection will be subject to an annual charge. However, Budget 2001 allows for tax relief up to a maximum of £150.

There is a voluntary agreement by the packaging interests – producers and users - to meet the EU recycling target for packaging, and to thereafter continue to increase the percentage of packing re-used and recycled. Unless these instruments are fully implemented, the ambitious targets are unlikely to be met.

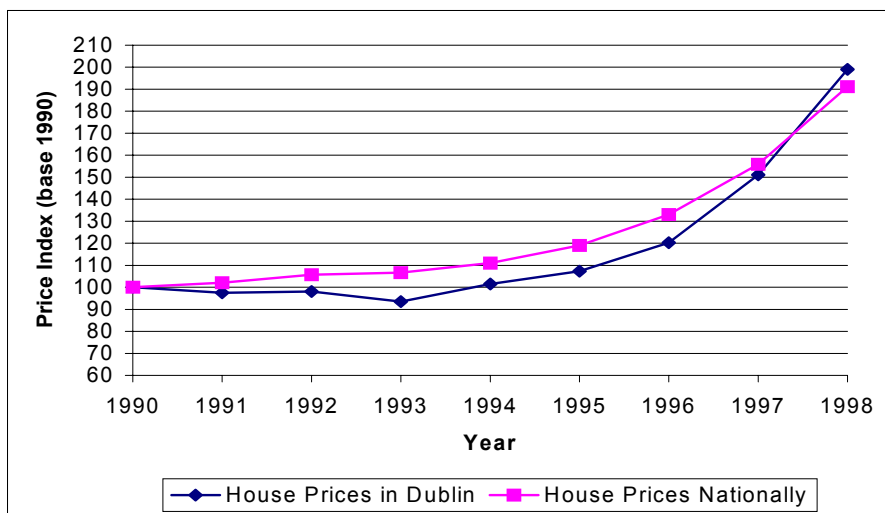
In regard to long-term sustainability, perhaps the most serious problem is the 74,000 tonnes of hazardous waste (25 percent of the total) that is ‘unreported’. Some of this is likely to produce a toxic time bomb in the future, which will impose large costs both in terms of immediate environmental impact, and costs of clean-up.

ENVIRONMENTAL ISSUE 5: ACCOMMODATION AND SETTLEMENT

Performance

The dynamic growth of the Irish economy has resulted in immigration into Ireland; between 1994 and 1999, a total of 236,000 persons immigrated into Ireland, with the highest annual figure, 47,500, taking place in the year to April 1999, and about half of it locating in the Dublin region (Williams and Shiels, 2000). This combined with natural growth has increased demand for housing.

Figure 4: House Prices in Dublin and Nationally, 1990-1998



Source: Personal Communication, Anthony Murphy (University College Dublin).

Production of housing has responded to this rising demand, with supply rising from 34,590 in 1996-'97 to 44,371 in 1998-99. However, the relative inelasticity of supply has resulted in rapidly rising house prices, with real prices increasing

nationally by 91 percent between 1990 and 1998. The price rise over this period has been particularly notable in the Dublin region, being 100 percent (Figure 4).

Much of the energy in the new Dublin economy is deriving from developments along the 'C ring' motorway circling the city to the west, with nodes at Swords/Dublin airport (Motorola, Hertz), Blanchardstown/Mullhudart (IBM complex), West Dublin/North Kildare (Intel, Hewlett Packard), Tallaght (City west, Park west) and Leopardstown/Sandyford (Microsoft, Cherrywood Technology Park). This development of an 'edge city' is symptomatic of developments in many urban areas, but has happened with particular rapidity in the Dublin region. Except for some apartment development in the inner city, most housing is low density suburban, and this process of urban sprawl and dispersal seems to be accelerating, with much of the development leapfrogging the established commuter belt. Between 1997 and 1998, the level of planning permissions for new housing in the outer Leinster counties (60 km+ from Dublin) grew by 40 percent, compared with a 14.7 growth in the Dublin region, and long distance commuting by rail and bus, but mainly by car, is becoming characteristic.

A large proportion of the new starts are one-off houses in rural country side, with the architectural style often selected from a pattern book, with little or no original architect design input, and often with little reference to indigenous styles of building and landscape. The result is a tension between those who have an interest in conserving landscapes and maintaining this endowment for themselves and for visitors, and landowners – for whom the sale of a site or sites provides a handsome capital gain - and those in need of relatively low cost housing, who need a site to provide themselves with affordable living space. There seems to be little consensus locally as regards what is acceptable and desirable in this regard, and so planners and policymakers find themselves fighting battles – which they often lose – with the 'one off' house. The wider issues of the costs of servicing these houses as regards infrastructure and social services, including protection, are also germane to this debate.

There are substantial costs implied by this pattern of development, including long commuting times for the new householders, increased pressure on road and rail infrastructure, with increased congestion, and, in the case of car transport, increased emissions to air, and loss of amenity and landscape value in the countryside. Because some of the development is taking place in small villages that lack the infrastructural and other capital to absorb such development, there are external costs being imposed on existing residents.

Response

Beginning in 1986, a rolling series of tax incentives have been provided for development in inner cities and towns. This has contributed to arresting the economic and demographic decline, such that, in general, the economic and social life in many inner urban areas is now quite robust. This single track policy has

become more focused, with the issuing of *Urban Renewal Guidelines* and the preparation of integrated area plans prepared by local authorities based on criteria provided by an expert advisory panel, including urban design, sustainable land uses, education, training, local economic development, environmental improvement and traffic management. In a word, there is a systematic attempt to use the planning system to internalise external costs, and foster the production of external benefits. However, this type of micro planning does not address the wider strategic issues of linking rapid expansion of housing to infrastructure provision and land use planning, notably in the greater Dublin region. Local authorities have been provided with funding to provide water and sewage services for housing land, and to acquire such land, and there is a Planning Bill before the Oireachtas (Legislature) designed to 'streamline' some aspects of the planning system.

The Future

The present policy mix will continue the process of low density sprawl, and the consequent loss of greenspace, long commute times, and associated congestion and environmental pressure. The substantial proposed investment in mobility in Dublin, with new light rail, metro and bus lanes provides an opportunity for reducing these external costs, by intensifying residential and associated development at nodes along these transport corridors. Parallel opportunities exist in the other urban areas – Cork, Galway, Limerick and Waterford.

SECTORAL ISSUE 1: TRANSPORT

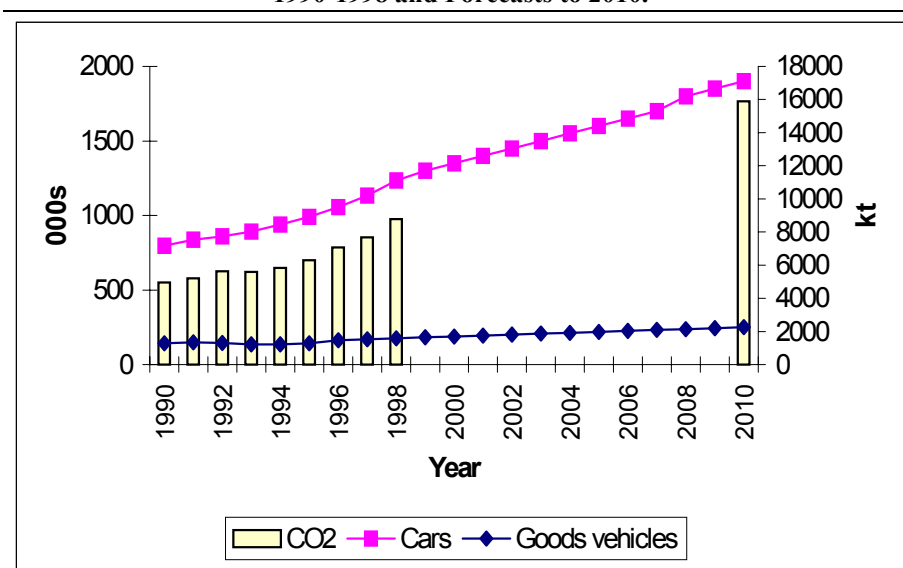
Performance

The principal environmental threats from the transport sector in Ireland relate to air transport, addressed in the Tourism section below, and road transport. Land-based transport in Ireland is heavily dependent on the road network with over 27km of roads per thousand people (relatively high by EU standards) and a relatively modest rail network. The principal impact upon quality of life in Ireland comes from the rapid expansion in private vehicle numbers as disposable income rises. The total number of vehicles has increased by more than half (Figure 5) and there has been a 34 percent increase in the number of cars per thousand of the population between 1990 and 1997 (DTO, 2000).⁸ Such an expansion in numbers has considerable implications for vehicular emissions and congestion in urban areas, in particular, in Dublin as improvements in road networks, traffic management and public transport have not kept pace.

Peak-time journeys into the Dublin region increased by 64 percent between 1991 and 1998 and the modal share accounted for by public transport has actually fallen by 8 percent. The number of taxi plates is restricted and peak queuing time at taxi ranks in Dublin can be more than 60 minutes. It is estimated that, at current fare prices, an extra 3,000 taxis are required to clear the market (Department of the Environment and Local Government, 1999). Average vehicular speeds in peak-time

traffic have fallen by 23 percent (from 18 to 14 km/hr) resulting in an average increase in journey times of 62 percent. It is estimated by the Dublin Transportation Office that congestion costs in terms of lost time amount to £0.5 billion per annum. While car ownership has a positive effect on a person's quality of life, the increase in congestion is probably the most apparent negative effect on urban residents of rapid economic growth in the economy.

Figure 5: Vehicle number and Related CO₂ emissions, 1990-1998 and Forecasts to 2010.



Sources: Derived from Environmental Resources Management Ltd. (1998) and McGettigan and Duffy (2000).

Response

Supply-side:

- A total of 11 "quality bus corridors" (bus lanes that operate from 7am to 7pm with traffic signal priorities) will be implemented shortly.
- When completed, the total length of cycle lanes in Dublin will amount to 160km
- Wheel clamping and tow-away services were introduced in the Dublin area in 1998, which has resulted in a 60 percent decrease in illegal parking.
- A traffic control centre with associated CCTV camera networks and computerised traffic signals has been introduced to improve traffic flows in

Dublin. VMS signs, which announce the number of spaces available in multi-storey car parks, have also been installed.

- Facilities for pedestrians have been improved by the gradual introduction of pedestrian-only areas and an increase in "green man" time on traffic lights. However, this has had a negative effect on traffic flows.
- In November 1999, the Minister of State at the Department of the Environmental and Local Government announced the creation of 3,100 taxi licences for Dublin. Given that taxi licences were trading at about £70,000, the Minister decided to allocate an extra licence to each of the 2,700 licence holders in the Dublin area to avoid potential disruption from protests. The issuing of new licences was to begin in early 2000. However, court action taken by the Hackney Association overturned the decision to allocate most of the licences to current licence holders. While this delayed the introduction of the new licences it led to the complete deregulation of the market. There are currently 3,500 hackney (hackneys are basically like taxis except they may not pick up on street, they must be telephoned) licences in Dublin and the number is increasing by about 100 per month (Dublin Corporation, 2000).
- Traffic will be diverted away from Dublin city centre upon completion of the Dublin Port Tunnel and the Eastern Bypass.
- In July 2000, the Government announced the funding of a (fully segregated) light rail system (Luas) consisting of 2 lines with completion not expected before 2003. In addition, the Government approved, in principle, to develop a metro for Dublin consisting of three lines including one to Dublin airport, which is presently without a rail link.
- The Government has provided funding for an extra 125 buses for Dublin and 60 rail cars in an effort to meet excess demand and reduce overcrowding on suburban rail services.
- £500 million is being invested in upgrading the rail network
- There are no park-and-ride facilities at present in Dublin but it is proposed to introduce two in the near future (Dublin Corporation, 2000).
- The Minister for Public Enterprise published a consultation paper in September 2000 which contains proposals for regulatory and institutional changes in the public transport sector which is heavily regulated and dominated by semi-state companies. The paper proposes a competitive model for the regulation of the bus market in the Greater Dublin area, where exclusive route franchises for a set time period (probably 5 years) would be awarded by an independent regulator following competitive tenders.
- Regional public transport measures are being introduced including bus and rail improvements in Cork, and bus improvements in Limerick, Galway and Waterford and pilot measures to encourage community-based public transport.

Demand-side:

- A government commissioned report by Oscar Faber recommended a road-pricing charge of £3 per car entering Dublin city centre during peak hours and estimated that the system would pay for itself within 1 year. However, the

recommendations have not been adopted and there is no use of congestion charging at present.

- Prior to Budget 2001, excise duty on motor fuels was as follows: £361/kl leaded petrol (from 2000, lead replacement petrol), £294.44/kl unleaded petrol, £256.14/kl diesel/gas oil, £104.65/tonne LPG, £256.14/kl kerosene. The duty differential combined with EU regulations have seen the share of unleaded petrol rising steadily over the 1990s to over 85 percent. VAT on motor fuels (other than kerosene) is charged at 21 percent. However, in an effort to reduce inflation, Budget 2001 reduced the tax take on unleaded petrol by 2p per litre and on road diesel by 6p per litre. Revenue accrues to the general budget.
- The sales tax rate on private vehicles (VRT) varies depending on whether the engine is above (28 percent) or below 2,500 cc (22.5 percent). This was introduced as a luxury tax rather than an environmental tax and the charge does not take into account engine characteristics such as emissions and noise. However, the 2001 Finance Bill provides for a refund of 50 percent of VRT due at the appropriate cc. rate to purchasers of hybrid (battery and petrol) motor vehicles.
- Annual road tax on private vehicles is based on engine size (from £92 for engines of less than 1,000cc to £800 for greater than 3,000 cc). The annual tax for electric vehicles is £92. The revenues go to local authorities. Again, the taxes were originally luxury taxes but are now claimed to be environmentally related but fail to take account of the noise and emissions characteristics of the cars.
- All public transport is exempt from VAT but the subsidies are amongst the lowest in Europe.
- Commuting expenses are subject to tax and the use of company cars is treated as benefit in kind (30 percent of the original market value of the car).
- Grants available under the 'scrappage scheme' to dispose of cars greater than 10 years old. Vehicle testing introduced in 2000.
- The Office of the Director of Traffic in Dublin Corporation has introduced charges for on-street parking of 80p in the suburbs and low demand areas and £1 in high demand areas in the city centre with a time limit of 3 hours. This has increased the turnover of on-street parking and increased the availability of spaces to shoppers and those on short visits at the expense of commuters. The Corporation has recently introduced a new schedule of charges ranging from 50p to £1.50 in peak areas. All revenues are ring-fenced for traffic management measures.
- In multi-storeys in Dublin it is a legal requirement that the marginal cost of parking increase with the length of stay. However, there is tax relief on the construction of multi-storey car parks in the city centre.
- A Group advising the Minister for Finance has recommended the introduction of a tax on parking as benefit in kind. However, no announcement has been made by the Minister regarding whether he supports the recommendation. The Director of Traffic of Dublin Corporation supports the proposal. However, there is opposition from motoring groups who suggest that the lack of and/or

shortage of alternative modes of transport will merely result in the tax being revenue raising. It is notable, that despite deliberating for some time, the advisory group has not published any details of how such a tax scheme would operate and it seems that this is another area where research is lacking.

The Future

Using vehicle numbers as a rough proxy for congestion, it can be seen in Figure 1 that, of the environmental pressures presented, congestion is the most highly correlated with GDP growth. Indeed, car ownership is growing at over 7 percent per annum (DTO, 2000). Measures to control the demand side include annual road and sales taxes on vehicles. However, without significant changes to the rates, they will not stem the rapid growth in car ownership and trip frequencies. Also, the rise in oil prices has done little to reduce demand for petrol suggesting the price elasticity is very low and, thus, energy taxes may have little impact. It seems as if road pricing is unlikely to be introduced but second best approaches such as more comprehensive parking charges and taxes on parking as benefit in kind offer some potential.

However, unless the level and quality of substitutes to commuting by car can be introduced, the suspicion is that such measures will merely be revenue raising without actually reducing congestion. This difficulty has a knock-on effect on environmental emissions where it is recognised that it is extremely difficult to achieve significant reductions. The national climate change strategy hopes to have reductions in the transport sector reduce the Kyoto overshoot by about 20 percent via modal shift, increases in excise duty on fuels (although they were reduced in the last budget!), and greater fuel efficiency of vehicles (assisted by the voluntary agreement between the EU and European, Japanese and Korean car manufacturers to reduce CO₂ emissions from new cars by an average of 25 percent). However, the bottom line is that, if the supply-side measures are not forthcoming, demand-side measures are likely to have little effect.

In April 2001, the Taoiseach launched a consultation paper on new institutional arrangements for land use and transportation in the Greater Dublin Area. This proposes a new Authority for the Greater Dublin Area which will, *inter alia*, prepare land use and transport strategies and implementation plans and promote an integrated public transport system. It would be very beneficial if control of transport was to come under one director of traffic rather than the present system where a number of local authorities have control.

A report has been recently been prepared for the Department of Public Enterprise by Oscar Faber, Ecotec, Goodbody's and the ESRI on the environmental implications of Irish transport growth. This reports recommendations are shown in Box 2. The recommendations are very strong but it remains to be seen whether they will be adopted and, if so, whether such contentious issues as charging for workplace parking and increasing tax on motorcycles can be overcome politically.

Box 2. Recommendations of Report on Environmental Implications of Irish Transport

- Registration tax and circulation tax be differentiated more closely according to environmental damage. Focus should be on measures that encourage the production and purchase of more fuel-efficient vehicles rather than on fuel tax increases.
- Rebate of diesel for public transport should be replaced by explicit subsidies based on passenger kilometres.
- Workplace parking should be charged on a daily basis through the rating system rather than as benefit in kind.
- The feasibility of road pricing should be investigated as a medium to long-term measure.
- Based on the polluter pays principle, heavy goods vehicles (HGVs) are underpaying. HGV tax should more closely relate to external costs.
- Motorcycles should be more heavily taxed to reflect their contribution to accidents.
- Rebate on diesel for passenger rail should be replaced by a direct subsidy to Iarnrod Eireann (Irish Rail)
- The Irish Government should support the introduction of VAT and emission charges on air transport.
- Urban planning policies should complement the above.
- Traffic management measures should be reviewed and improved.

SECTORAL ISSUE 2: ENERGY

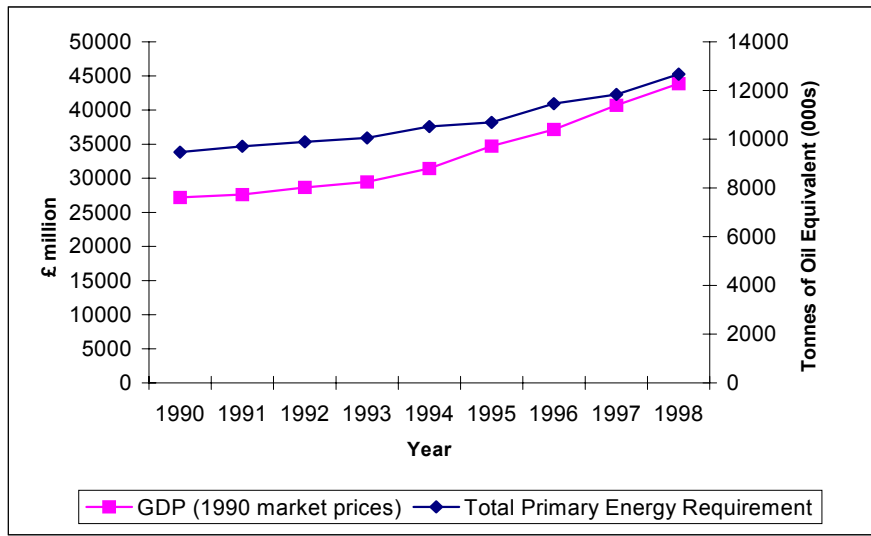
Performance

It is clear from Figure 6 that rapid economic growth has been accompanied by quite rapid growth in energy demand. Between 1990 and 1998 energy demand increased by 34 percent. However, it can be seen that, in the latter half of the 1990s, growth in energy demand has been less fast than economic growth as energy intensity overall has fallen due to some combination of improved efficiency and the restructuring of Irish industry (although electricity demand per worker more than doubled over the 1990s due to the increased use of electronic/electrical equipment). There has been a slight improvement in the residential sector but energy efficiency in the transport sector has remained largely unchanged and the sector has become the largest, and fastest growing, user of energy accounting for over one-third of energy demand in 1998 (Stapleton *et al.*, 2000).

The breakdown of fuels used to generate the primary energy requirement is shown in Figure 7. As can be seen, Ireland is still quite reliant on imported oil (56 percent).

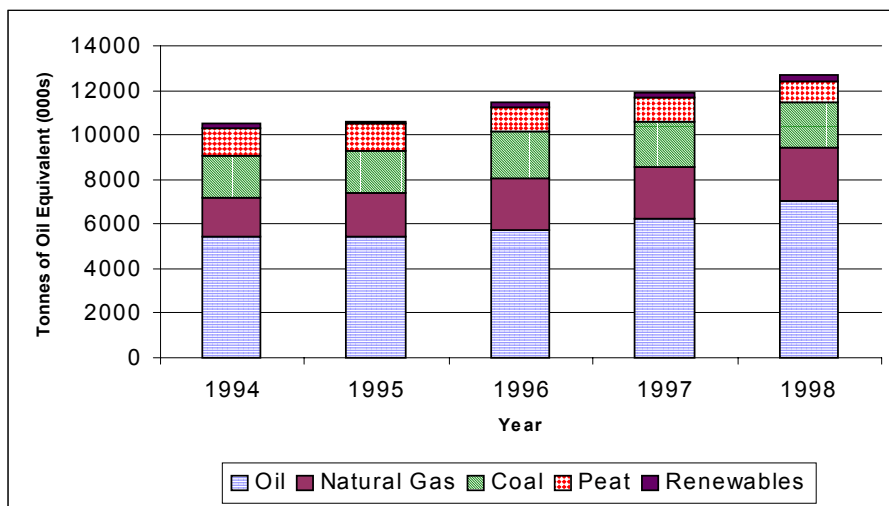
While the real price of energy has declined over the decade, oil price rises in 1999/2000 have added to the inflationary pressures experienced by Ireland of late.

Figure 6: Total Primary Energy Requirement and GDP, 1990-1998.



Sources: CSO (2000); Department of Public Enterprise (2000); Lehane (1999).

Figure 7: Sources of Primary Energy, 1994-1998.



Source: Department of Public Enterprise (2000).

Increases in energy demand are a particular concern when energy generation is based predominantly on fossil fuels, the burning of which results in emissions of greenhouse gases and acidification precursors. The largest power plants use oil and coal. 60 percent of SO₂ emissions, 30 percent of NO_x emissions and 22 percent of all greenhouse gas emissions arise from power stations. Renewable energy, comprised mostly of hydro-power makes up just 2 percent of Ireland's primary energy requirement.

Emissions of acidification precursors and greenhouse gases have not kept pace with growth in primary energy demand largely as a result of a shift to low sulphur coal in coal-fired power stations and increased use of gas-fired plants. However, while emissions of SO₂ have been declining in other EU countries, the large increase in demand for energy in Ireland has resulted in higher output from oil-fired plants and, consequently, SO₂ emissions have not been reduced over the decade. NO_x control technology was fitted to most of the power plants during the 1990s and there has been a reduction in emissions of NO_x from the plants during this decade. Directive 88/609/EEC on large combustion plants sets emissions limits of 124,000 tonnes for SO₂ and 50,000 tonnes for NO_x for Irish power plants of greater than 50 MW thermal capacity (Stapleton *et al.*, 2000). While the power plants are in compliance with this Directive, as discussed earlier, the Gothenburg Protocol sets new targets (across all sectors) of 42,000 tonnes of SO₂ and 65,000 tonnes of NO_x which set new challenges for the power generation sector. The proportion of CO₂ emissions accounted for by the power generation sector has remained relatively constant since 1990.

Response

- Natural gas penetration is growing and is central to Ireland's strategy to reduce emissions of CO₂ and SO₂. Almost half of the gas supply is coming via the interconnector between Ireland and the UK and this percentage is expected to increase (Stapleton *et al.*, 2000).
- The Environmental Resources Management (1998) report produced for the Department of the Environment and Local Government showed that replacing Moneypoint (coal) and the oil and peat plants by Combined-Cycle Gas Turbine (CCGT) plants would reduce emissions of greenhouse gases by 5.6 million tonnes (about 40 percent of the Kyoto overshoot) at negative cost. However, these costs do not include the political costs of closing certain stations.
- A Green Paper on Sustainable Energy was published in 1999 which announced £126m Exchequer funding for energy-related CO₂ abatement with a discussion of the issues vis-à-vis further refinement of policies and their implementation.
- This has been complemented by the national climate change strategy. The two key instruments suggested are fuel switching and improvements in the efficiency of energy transformation. The main strategies are to encourage the further switch to natural gas (saving 4.95mt of greenhouse gases per annum) and the replacement of the coal fired plant at Moneypoint by a CCGT plant by (saving 3.4mt per annum). Other initiatives involving the closure of the older peat plant, substituting for oil,

encouragement of the adoption of Combined Heat and Power (CHP), improving generating efficiency and demand-side management are expected to save 2.05 mt per annum. Finally, in line with the Green Paper on Sustainable Energy, renewable energy sources will reduce emissions by a further 1mt (see below).

- While renewable energy generation is minimal, there have been a number of initiatives to introduce wind power. Full planning permission has been granted to wind farms with a combined installed electricity generating capacity of 155 MW with a further number, which combined, will offer a further 160 MW subject to planning permissions. However, there are potentially large negative environmental impacts of wind farms with regard to landscape impacts and noise, although these may be mitigated by moving some of these off-shore. The target of the Green Paper on Sustainable Energy is for 500 MW to be produced from all sources by 2005. A Renewable Energy Strategy Group (2000) has just reported their recommendations in this regard.
- Unlike what pertains in relation to greenhouse gases, it is notable that there has been no strategy developed to address emissions of acidification precursors. However, some of the initiatives in the greenhouse gas strategy such as the closure of Moneypoint power station and general reductions in energy use will have positive effects (it will avoid the necessity to install Flue Gas Desulphurisation) as will further substitution of coal and oil with natural gas.

The Future

The targets set in the climate change strategy are to be welcomed as they will both improve efficiency and reduce emissions. However, a heavy load has been placed on the energy-generation sector by giving it 44 percent of the reduction in greenhouse gas emissions. It remains to be seen whether this target can be achieved. It seems unfortunate that a strategy does not seem to have been developed for reducing acidification precursors from power generation given the severe ceilings faced, particularly with regard to SO₂. However, the initiatives set out in the climate change strategy will assist somewhat.

SECTORAL ISSUE 3: AGRICULTURE AND FORESTRY

Performance

Farm output in Ireland is dominated by grass-based dairy and beef production, but there is some arable production, and the sector includes some of the largest pig producing units in Europe. Because of quota and related restrictions, volume of output has been very static, so the environmental challenges that have emerged in recent years are not driven by overall growth, but by changes in the manner in which the static levels of output are produced, and the recognition of 'new' challenges. Irish farmers are facing new environmental challenges – global warming and acidification. Of these two, acidification is going to prove to be the most intractable. For some farmers, the existing problems of eutrophication, groundwater contamination and biodiversity are going to intensify in significance.

Global warming: Agriculture contributes over one third of greenhouse gas emissions, and we are likely to have to meet a very restrictive national quota in this regard. In the short run, farming is unlikely to be targeted as a sector to cut back; the costs of doing so are high, and there is a trend downward in sectoral emissions. In the medium term (5-10 years) when a market for emissions is likely to have been created, the farmers who have relatively low cost opportunities for investing in abatement of emissions, e.g. intensive pig farmers, will be offered joint venture type investments, where the farmer is subsidised in whole or in part to provide a digester for methane, and the partner can use the ensuing reduction as a credit against obligations. For livestock farming with very low returns, such as beef and sheep, the option of getting out of business, and selling the ensuing greenhouse gas emission reduction, may become a feature.

Acid Rain: When certain chemicals (known as ‘acid precursors’) are released into the atmosphere, they are converted into acid and fall to earth as dry deposition or acid rain. The external costs associated with such deposition are as follows: the biological ‘death’ of lakes which are susceptible; release of toxic metals from acid soils; crop losses. Because acid precursors can cross national borders and emissions from one country can adversely affect other countries, the problem can only be solved through international co-operation. Negotiations to agree national emission ceilings for acidifying chemicals were completed in late 1999 under the auspices of the United Nations Economic Commission for Europe. The main acid precursors are sulphur dioxide (SO₂), nitrogen oxides (NO_x), and ammonia (NH₃). Under business as usual, Ireland is expected to emit 126,000 tonnes of ammonia (NH₃) by the target year (2010). Ireland has agreed to reduce its ammonia emissions to 116,000 tonnes by 2010. Preparations are also being made for an EU directive that would set national emission ceilings. Almost all of Ireland’s ammonia emissions come from agriculture, mainly deriving from the application of nitrogenous fertiliser and animal waste. Preparations are also being made for an EU directive on national emission ceilings.

Nitrate in Groundwater: Groundwater is the source of about 15 percent of public authority water supplies and about 25 percent of all water supplies in Ireland. It is also vital for the Irish mineral water industry. These water supplies can be adversely affected by contamination with nitrate from agricultural systems. Nitrate that leaks from the farm system and ends up in groundwater supplies can have the following negative effects:

- Nitrate concentrations exceeding 50mg/l are associated with an increased risk of methaemoglobinaemia (‘blue baby syndrome’), a potentially life-threatening disease, in infants.
- Nitrate in drinking water breaks down into nitrite, which reacts with compounds in the stomach to form products that have been found to be carcinogenic in many animals (though the link to cancer in humans is unproven).

- A recent EPA (1999) study which analysed water samples taken between 1995 and 1997 found that 2.6 percent of groundwater samples had nitrate concentrations exceeding 50 mg/l, the latter being the EU limit value (see discussion below).

Eutrophication: When freshwater lakes and coastal waters have high concentrations of certain nutrients – mainly phosphate compounds and, to a lesser extent, nitrogen compounds – the oxygen balance is disturbed, often leading to loss of fish, diminished aesthetic quality, reduced amenity value and deterioration in the quality of drinking water.

Most nitrate and phosphate found in natural waters comes from external organic and inorganic sources – mainly from sewage and industrial waste discharges, and from diffuse sources such as forestry, agriculture and domestic septic tank systems. As noted earlier, agriculture is a significant of eutrophication in Ireland (Table 12).

Table 12: Freshwater Pollution Attributable to Agriculture by Intensity, 1995-1997.

<i>Degree of pollution</i>	<i>% of cases attributed to agriculture</i>
Slightly polluted	47
Moderately polluted	46
Heavily polluted	25

Source: EPA (1999, p. 10).

Biodiversity: The word ‘biodiversity’ is a contraction of the term ‘biological diversity’, an imprecise term used to refer to the number, variety and variability of living organisms. Biodiversity refers to both *genetic diversity* – the heritable variation within and between populations of organisms which allows both natural evolutionary change and artificial selective breeding to take place – and *species diversity* – the variety of species in a habitat – both of which are difficult to define and quantify.

In 1992, a Convention on Biological Diversity (CBD) was negotiated under the auspices of the United Nations Environment Programme. Ireland ratified the CBD in 1996. Article 6 of the Convention obliges states to ‘develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity’.

Agriculture has enriched Ireland’s biodiversity over the millennia. However, recent changes in agricultural practices – in particular, intensification and specialisation of farms – have threatened biodiversity in a number of ways.

Intensification of farming has threatened many breeds and varieties of crops and livestock. A number of Irish cattle breeds – including Kerry, Irish Maol (or

Moilled) and Dexter cattle – are now considered endangered (The Heritage Council, 1999).

The biggest threat to biodiversity comes through habitat destruction and habitat fragmentation. The most significant threats to Irish habitats (the loss of upland heather moor and blanket bog, for example) result from practices other than intensive dairy farming, such as afforestation activities in the wrong place, and over-grazing of land by sheep (Murphy and Lally, 1998). Modern farming has contributed to habitat destruction in several ways, including State funded arterial and field drainage and land reclamation, which destroyed wildlife habitat, and the production of silage which increased from 0.3m tonnes in 1960 to over 20m tonnes in 1990, and has been linked to the decline of a number of species, most notably the corncrake (*Crex crex*).

Early grazing of grassland, which is subsequently closed off for silage production, reduces habitat availability during the early nesting season.

The agricultural use of nutrients can lead to the enrichment of both agricultural and non-agricultural land (the latter through run-off, leaching and drift). Nutrient enrichment impacts on the competitiveness of species adapted to nutrient-poor conditions (e.g. ‘non-weed species’ in the Burren limestone grasslands were reduced in yield, variety and percentage cover by fertiliser application). The areas most sensitive to this are heathland, calcareous grassland (i.e. that containing calcium carbonate) and oligotrophic waterbodies. Eutrophication can lead to excessive growths of algae and other water quality and may cause deterioration of water quality to the point of the “collapse” of an ecosystem through oxygen depletion.

Response

There have been no agriculture-specific policy responses in regard to global warming and acidification. With regard to nitrates in groundwater, the response has been driven by the requirements of the EC Nitrates Directive (1991) which sets a maximum admissible concentration (MAC) of 50mg of nitrate per litre of water and a recommended limit of 25mg/l. The directive also obliges Member States to monitor ground and surface waters and to designate nitrate-sensitive zones (where nitrate concentrations exceed 50mg/l or are likely to do so). Member States must designate freshwater, estuaries, coastal and marine waters which are found to be eutrophic from nitrates or which are likely to be in the near future. Annex II of the directive sets out a Code of Good Agricultural Practice, which the Department of the Environment and Local Government and the Department of Agriculture, Food and Forestry have published and distributed (Department of the Environment and Department of Agriculture, 1996). Annex III sets out measures that must be taken by Member States.

In response, the Department of the Environment and Local Government is conducting a survey to identify nitrate-sensitive zones, and Cork County Council has

passed bye-laws regulating agricultural activities in three nitrate sensitive areas in the county. The bylaws include specifications as to soil testing (at least once every 4 years) rate and timing of application of slurry (all spread by October 31) and fertiliser (no chemical N applied October – December), and requirements to leave buffer strips along water courses, wells etc. (no slurry spreading within 10 metres of water courses). These bylaws are being used also to control eutrophication problems, and meet water quality standards.

The response to the damage and threats to biodiversity are now driven by the 1992 *Habitats Directive* which requires Member States to maintain or restore certain natural habitats and species. Member States are required to designate *Special Areas of Conservation* (SACs) for habitats which are in danger of disappearing or represent outstanding examples of their type and for a limited number of species. Ireland is expected to designate 400 SACs, totalling about 650,000 hectares. These designations get integrated into Development Plans, and this in turn shapes decisions on planning permissions, and the awarding of grants for afforestation. The main instrument as regards farming is the *Rural Environmental Protection Scheme* (REPS) that provides annual income to farmers who participate and act positively to protect biodiversity, archaeological and natural features, including water courses. There are additional supplementary payments for participants whose land lies, wholly or partly, within areas designated for habitat conservation, and participation is obligatory in Special Areas of Conservation.

The Future

Information, command and control and subsidies are all employed to improve the environmental performance of farming in Ireland as regard nitrification, eutrophication and biodiversity conservation. But the data available all relate to inputs, rather than outputs, so it is not clear to what extent this effort is yielding internalisation of external costs and expanded output of external benefits (mainly biodiversity related). Irish farmers are facing new environmental challenges – global warming and acidification. Global warming is likely to pose more of an opportunity than a threat, in that farmers reducing their stocking permanently, investing in methane recovery systems or afforesting may receive a credit via the market in emission trading that is likely to develop for carbon dioxide.

In regard to acidification, there is now a legally binding quota for ammonia emissions, and under ‘business as usual’ we will exceed the quota. Since ammonia comes mainly from the farming sector, some policy intervention will be required. A combination of tax changes to encourage farmers to switch from urea to CAN, and requirements to switch from splash plate spreading of slurry look to be the most promising interventions. As regards eutrophication and nitrification, the poor performance of Ireland in this area is going to require a substantial improvement; the bylaws applying to a few catchments in Cork are likely to become much more pervasive, and this will impose costs on farmers and on Teagasc and other

administrative processes. Weather is a complicating factor for both farmers and policymakers as regards addressing acidification, eutrophication and nitrification.

SECTORAL ISSUE 4: TOURISM

Performance

Tourist numbers have increased by about 80 percent since 1990 (Figure 8). This increase has resulted in a variety of environmental costs and benefits. These consist of:

- Direct costs imposed by visitors during their visit, including emissions generated by access transport (mainly air and sea), congestion and pollution generated by transport within the country, increased consumption of water consumption, additional sewage generated, increased packaging use and associated solid waste generated, and pressure on sensitive environments where assimilative capacities are exceeded.
- Indirect costs, generated by the need to supply accommodation and entertainment to visitors. Such provisions include hotels, hostels, caravan sites, hiking trails, golf courses which can impair scenic vistas, disturb or destroy sensitive habitats, and damage historic or architecturally interesting buildings of character.

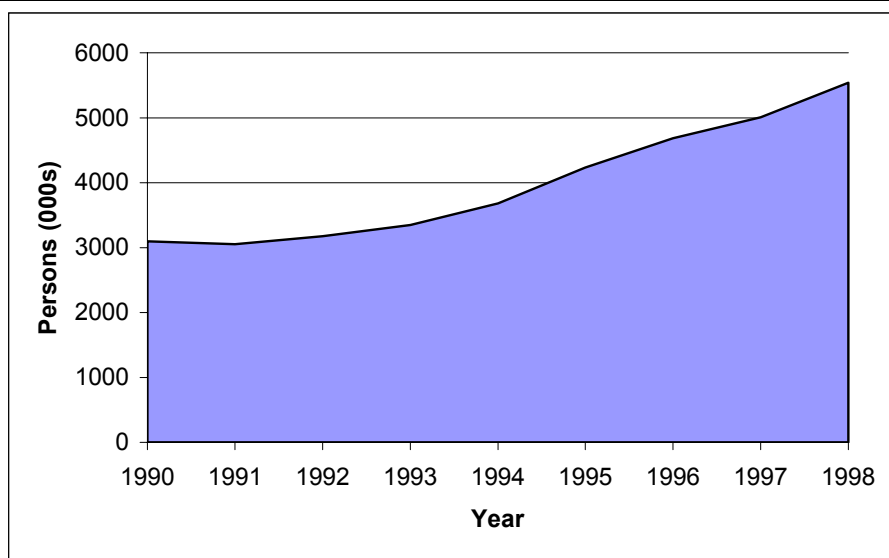
The potential environmental benefits relate mainly to the fact that tourists generate employment and income. The latter can provide some or all of the funding to support the restoration, conservation and operation of conservation endowments, including historic and heritage buildings and gardens, and archaeological features. In relatively remote areas, tourist income may make the difference between abandonment by humans of an isolated island or other community, and its maintenance as a viable social and economic entity.

There are no systematic data for tourist impact in this regard. However, Ridgeway (2000) has estimated the emissions associated with air access transport to Dublin. The main emissions, in rank order in terms of volume are carbon dioxide (CO₂), nitrogen oxides (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂) and hydrocarbons (HC). Carbon dioxide is a green house gas, an agent in global warming. Nitrogen oxides are implicated, with SO₂, in the creation of acid rain, and, with hydrocarbons, in the creation of ground level ozone. Carbon monoxide can interfere with the take up of oxygen by the body. Ireland produces no air traffic emissions inventory. She derived results for incoming flights to Dublin in 1998, when there were flights from 65 originating cities into Dublin. The findings are summarised in Table 13.

Bord Fáilte (Irish Tourist Board) produces facts from which can be derived the share of travel attributable to air travel. These are: 59 percent for Britain, 56 percent for mainland Europe, 75 percent for North America, and 74 percent for the rest of the world. Applying these percentages to the above yields the emissions attributable to

tourists coming in to Dublin (Table 14). It is likely that intra EU traffic will be ‘counted’ within national quotas, so that the mainland Europe and EU greenhouse gas contribution is likely to come within the Irish assigned amount. Likewise, the emissions of NO_x, or at least those generated at ground level, will have to be accommodated in the Irish quota.

Figure 8: Overseas Tourists, 1990-1998.



Source: Lehane (1999).

Table 13: Fuel Used and Emissions Generated by Flights Incoming to Dublin, 1998.

Category	Amount (000s of metric tonnes)
Fuel used	2190
<i>Emissions:</i>	
Carbon dioxide (CO ₂)	690
Nitrogen oxides (NO _x)	3.168
Carbon monoxide (CO)	0.76
Hydrocarbons (HC)	0.266

Source: Ridgeway, 2000

Table 14: Estimated Total Fuel Consumption and Emissions Generated by Tourist Air Traffic arriving into Dublin Airport during 1998 (metric tonnes).

Flight Origin	Total Fuel	Total CO ₂	Total SO ₂	Total NO _x	Total HC	Total CO
Britain	41826	131752	42	488	89	264
Mainland Europe	33581	105780	34	388	47	135
North America	63650	200496	64	1141	30	90
Rest of the World	9486	29881	9	168	6	13
Totals	148543	467910	149	2185	172	502

Response

The main response has been the selection and funding of a series of pilot projects, designed to identify environmentally compatible means of developing tourism while sustaining environmental endowments. The projects supported include: visitor management at Glendalough; visitor traffic management, Kerry; hill walking, Donegal; visitor management, offshore islands.

The Future

If the sector continues to expand, the congestion and environmental ‘hot spots’ will intensify as regards impact, and their number will increase. Apart from the emissions associated with air access noted above, there are no baseline data available indicating the environmental impact or performance of the tourism sector in Ireland. Without such data, it is impossible to put the sector in an overall context, to identify priorities for intervention, or to evaluate the effectiveness of such intervention. Repairing this basic information deficit should be a first priority. A second priority should be the identification and evaluation of policy interventions to improve the environmental performance of the sector. The lessons yielded by the case studies will be important in this regard.

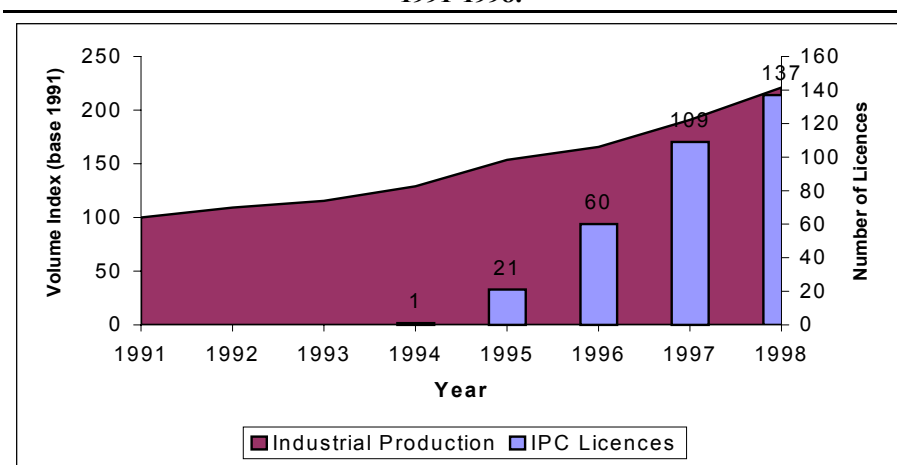
SECTORAL ISSUE 5: INDUSTRY

Performance

In the 1960s, the Irish economy shifted away from agriculture towards industry and services with the services sector now being dominant. The rapid growth in the Irish economy has been driven by the industrial sector. Industry accounts for 39 percent of GDP, 90 percent of exports and 29 percent of employment (Stapleton *et al.*, 2000). Rapid growth in industrial output (Figure 9) has increased pollution potential as it involves higher consumption of raw materials and energy and results in emissions to air and water and increased generation of waste (Lehane, 1999). However, the nature of the new industry is relatively ‘clean’ and controlled. Amongst other factors, favourable corporate tax rates and a relatively young and educated workforce have attracted large numbers of multinationals to Ireland,

predominantly in information technology, electronics and pharmaceuticals (multinationals now account for 70 percent of all exports). This restructuring away from heavy polluting industry and the replacement of capital with cleaner technology has meant that the increase in pollution has been less than might be expected given the massive increase in output. However, there are still exceptions, notably the cement industry, which produces 2.55 percent of all greenhouse gases, and the ammonia production industry, which produces 2.45 percent of such gases.

Figure 9: Volume of Industrial Production and Number of IPC Licences, 1991-1998.



Source: Derived from Lehane (1999).

Industry is responsible for about 13 percent of greenhouse gas emissions, 20 percent of SO₂ emissions and about 40 percent of all noise complaints in Dublin (Figure 10). It is predicted that the share of greenhouse gas emissions accounted for by industry will fall between now and 2010.

Response

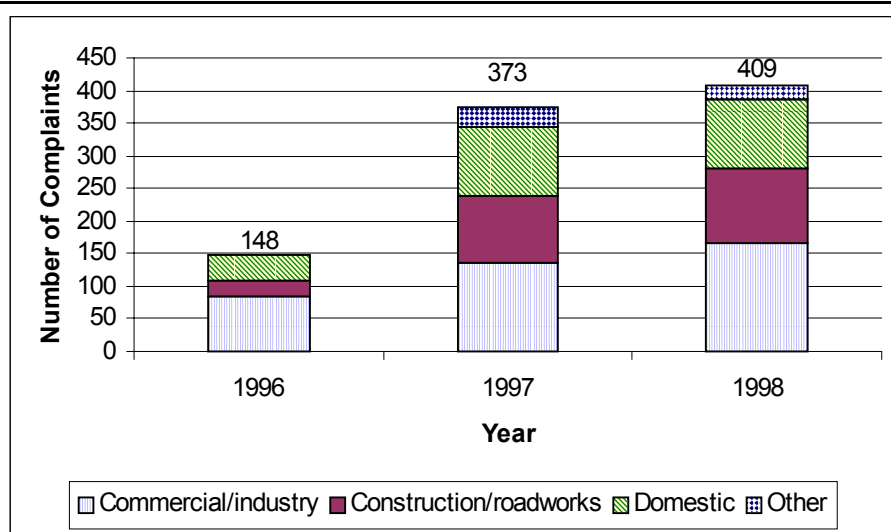
In response to the IPCC Directive, a major responsibility of the Environmental Protection Agency (EPA) is the issuing of Integrated Pollution Control (IPC) licences which began in 1994. Under IPC, a single licence is issued which covers air, water, waste emissions and noise. There are about 345 licences in operation at present and most pollution potential is covered by the licences. A new waste management act was introduced in 1996 which licences waste management facilities and disposal systems. None of these licences are tradeable and there are no other economic instruments in use.

The Future

Apart from the cement and ammonia industries, IPC licensing seems to be effective at controlling pollution. However, it is unlikely that this approach is least cost and it is debatable whether it promotes dynamic efficiency. Some investigation into whether economic instruments would be more efficient would be beneficial, in particular, whether emissions trading along the lines of the SO₂ and NO_x trading programmes in the US would be successful, whereby minimum emissions are licensed but further reductions may be traded.

In relation to greenhouse gas emissions, the climate change strategy proposes that the Irish Energy Centre will advise on energy-efficient technologies which will form the basis for negotiated agreements with the various sectors of industry. The first of these would be negotiated by 2002 and in place by 2005. Those industries/firms not in such an agreement would be subject to the energy tax (see Greenhouse Gas Emissions section). It is projected that reductions in the energy sector could reduce the Kyoto overshoot by about 15 percent.

Figure 10: Noise Complaints in Dublin, 1996-1998.



Source: *Lehane (1999)*.

9. CONCLUSIONS AND RECOMMENDATIONS

Ireland's situation is very robust if performance is judged on the basis of the 'weak sustainability' criterion, which tests whether a country's saving rate is positive after allowing for the draw-down of natural assets and the destruction of environmental endowments. Because it has a relatively low natural resource endowment to draw down, and high rates of GDP growth and net private and public investment (including in the latter investment in education and health) Ireland shows a very positive balance in 'genuine saving' having, in fact, the third-highest per-capita genuine savings in the world after Singapore and Japan.

A much more mixed picture emerges when individual environmental media and economic sectors are examined. When we review the 1990-1998 period, what we find, in essence, is the following:

Only one of the emissions to air that was tracked, carbon monoxide (CO), has declined unambiguously in absolute terms. VOCs and SO₂ have been oscillating but stable, while ammonia, NO_x and the greenhouse gases have been increasing. Thus there is no real evidence of 'decoupling' economic growth from growth in emissions, although the rate of growth of the latter was much lower than the rate of growth of the economy.

Two key indicators of quality of urban life, traffic congestion and cost of accommodation, have deteriorated substantially, with a doubling of the real price of housing and a 50 percent increase in car numbers over the period. Emissions of particulate matter and the increased incidence of noise complaints in cities are also of concern.

Environmental policy in Ireland is driven mainly by international agreements on global warming (Kyoto Protocol) and acid precursors (Gothenburg Protocol), and by European Union legislation across a range of imperatives, from emissions quality of waste water to conservation of habitats of European significance. As regards global warming and acid precursors, the business as usual scenarios indicate substantial overshoots of the assigned amounts under these agreements. Current and prospective concentrations of micro particulates (PM_{10s}) are likely to be in excess of the EU legislative limits, while water quality will have great difficulty meeting current and prospective standards. The increased supply of housing is still generally low density and dispersed, resulting in deterioration in landscape, imposition of costs on physical and social infrastructure, and long commuting distances, mainly by car, and associated emissions and congestion.

There are very large investments proposed in the National Development Plan 2000-2006 to address environmental issues, including water and waste water (€3.168 billion), solid waste (€0.825 billion), farm waste (€0.185 billion), rural environmental protection, including habitat protection (€1.905 billion) and public transport (€2.555 billion). However, it is clear that the current policy mix, mainly

regulation / command and control, direct investment (waste water and public transport) and subsidies (mainly to farmers), will not achieve compliance with international agreements and European Union requirements; neither will they internalise relevant costs in those areas where European Union legislation is not yet active (housing and congestion). Sets of hybrid policies that draw on the mobilisation of market forces will be required to bring our performance into line with what is required to fulfil our obligations and our needs. This is the trend now in other EU Member States (Clinch, 2000), and this experience should be drawn upon in developing a market-based strategy.

Taxes and charges to signal environmental scarcity have hardly been used as environmental policy instruments in Ireland. A combination of charges on NO_x and SO₂ emissions, with substantial rebates, would, in combination with other instruments, help Ireland achieve its obligations under the Gothenburg Protocol. A tax on carbon emissions, rebated if benchmark targets are met, would be an important animator of progress in regard to climate change. The development of a toxics release inventory on the US model (with annual reporting of inputs and outputs of specific toxic substances) would provide a strong incentive to reduce toxic releases. The introduction of metered charges for domestic water, the introduction of a land-fill tax, and charges on the basis of weight for domestic refuse, would all stimulate improved performance. However, it should be pointed out that the Irish public has proved very resistant to paying charges imposed on households, on the basis that such imposts are 'double taxation.' Property tax (domestic rates) and water charges on domestic households have both been eliminated. Property, water and refuse taxes were all charges as an annual fixed cost, so it may be, but it is by no means certain, that the public would be more willing to accept such charges if they were based on actual use or consumption. With rapid economic growth, the government is generating large and growing budget surpluses. While this situation continues, there is likely to be great reluctance to incur the political costs of imposing charges, when there is no fiscal need to raise revenues. However, the likely introduction of a plastic bag tax and landfill tax is to be welcomed. It is a remarkable development that the funds (estimated to be around £140 million per annum) will be hypothecated to an 'environmental fund'.

The use of emissions trading to help achieve compliance with the Kyoto Protocol envelope is likely to be adopted when a market wider than the (very small) domestic market can be created, and this is to be encouraged. To reduce opposition from manufacturing and commercial interests, it is likely that at least some of the assigned amounts will be allocated for free, with some auctioned. How this system is designed and operates will depend very much on the design and operation of the European Union system.

In the whole area of policy design and execution, there is a need for an ongoing research programme, that would, at a minimum, bring systematic information on the best international practice into the Irish academic and policy process.

An important consideration in policy design is to achieve synergy across policy areas, the most striking potentials in this regard being global warming and acid precursors; progress in energy conservation, and a switch from coal and peat to natural gas would simultaneously advance both agendas.

Some suggestions for policy intervention are presented in relation to each issue in Table 15. This is intended not as an integrated package of measures, but an indicative list of possibilities. These initiatives, if acted upon, would introduce market forces in support of environmental conservation. However, the design and implementation of such interventions will be substantially enhanced if a research programme runs in parallel, which includes the following elements: collection and analysis of site-specific data in Ireland; pilot testing of specific policy interventions; collection, synthesis and application of best international practice. A particular focus should be on the estimation of the environmental responsiveness of proposed market-based interventions, economic efficiency and equity effects, and implementation mechanisms. In addition, research on calculating appropriate taxes and charges using environmental valuation should be supported. At present, we must rely on using figures from other countries (benefits transfer) which may be inappropriate.

If the market can be effectively mobilised in support of environmental quality, then economic growth and conservation of environmental endowments can be reconciled and made mutually supportive. Without the use of market-based instruments, this is unlikely to happen.

Table 15A: Revenues from Environmental Taxes.

<i>Rank order – Share of GDP</i>	<i>Rank order – Share of Tax revenues</i>
1. Denmark	Portugal
2. Portugal	Iceland
3. Netherlands	Ireland
4. Ireland	Denmark
5. Finland	Norway
6. UK	UK
7. Sweden	Netherlands

Source: OECD (1999).

Table 15: Key Environment-Development Issues and Recommended Market Interventions.

<i>Environmental Issue</i>	<i>Performance</i>	<i>Recommended Market Interventions</i>
1. Meeting Kyoto greenhouse gas emissions target	Under business as usual, The 61 million tonne CO ₂ -equivalent target will be substantially exceeded	Examine every existing energy-related tax and re-calibrate them to improve their environmental effectiveness [Ireland ranks 4 th in the OECD in terms of the proportion of GDP accounted for by environmentally related taxation (see Table 15A)]. However, most existing taxes were not originally intended to be environmental taxes and could be more effective. Introduce emissions trading as quickly as feasible including volunteering for EU pilot schemes.
2. Meeting Acidification precursor targets Meeting standards for NO _x and PM _{10s}	Stabilising of SO ₂ emissions; nevertheless, under ‘business as usual’ projections, there will be substantial overshooting of targets agreed for SO ₂ (by 136 thousand tonnes), NO _x (by 60 thousand tonnes) and VOC (by 55 thousand tonnes). Downward trend in ambient air quality in cities, especially regarding PM ₁₀ and NO _x .	An acidification precursor abatement strategy is required that is integrated with the greenhouse gas abatement strategy. Introduce charges on NO _x and SO ₂ emissions with appropriate rebates etc. to be used to address equity and competitiveness concerns. Taxation could be used to encourage farmers to switch from urea to CAN to reduce ammonia emissions. See transport also.
3. Meeting water quality objectives in Irish and EU legislation	Downward trends in freshwater water quality. Major non compliance with EU drinking water Directive, and prospective non compliance with Water Framework Directive as regards no deterioration.	Remove the VAT exemption from chemical fertilisers. In order to ensure that the €3 billion investment in water supply and wastewater treatment is used effectively, households should pay directly for water. Economic efficiency, environmental and political feasibility will be improved if metering is used with unit charges rising with increased use. Equity issues can be addressed easily.

4. Stabilising waste emissions (hazardous and non hazardous)	All categories – agricultural, manufacturing, mining and quarrying, hazardous, municipal, construction and demolition, drinking water sludges – increased over the 1995-'98 period	Introduce the land-fill tax and use the lessons deriving from the pilot schemes testing weight-based charges to implement such a scheme. Implement a Toxics-Release Inventory to stimulate reductions in the use and disposal of toxic substances. Introduce plastic bag tax as planned.
5. Settlement and Meeting rapidly growing accommodation needs	The dynamic economy, back migration combined with natural growth in population has resulted in rapid growth in the demand and for housing. Although annual supply has increased from approx. 20,000 to 50,000 units over the past 5 years, prices have continued to escalate Settlement is spreading out in low density suburbs	With interest rates set by the ECB, efforts on demand-side will generally merely redistribute income. The supply-side is the key. A nationally-directed and funded scheme of compulsory purchase and servicing of land along key public-transport corridors, with the goal of adding a substantial increment to (preferably higher-density) housing supply would help to stabilise prices and prevent a sharp downturn in the future.
<i>Sectoral Issues</i>		
1. Transport	The growth in disposable income and population has led to a doubling of car numbers, and this in turn has resulted in serious congestion costs and increased emissions of NO _x and PM _{10s}	Supply-side is the key to increasing price elasticities. Press ahead with improvements in public transport and park-and-ride schemes. Traffic management of the entire Greater Dublin area should be the responsibility of one Director of Traffic. Re-structure annual vehicle tax and vehicle sales tax to better reflect the emissions, noise characteristics, and size of vehicles. Increase marginal costs relative to fixed costs of motoring. Reduce annual tax and use road pricing or second-best approaches such as parking pricing to increase marginal costs. Replace rebate on diesel for public transport with explicit subsidies based on passenger miles. Increase taxes on heavy goods vehicles. Continue to refine on-street and multi-storey parking charges to reflect scarcity of road space with a zoned system

2. Energy	Final demand for energy continues to grow in line with GDP growth, and under 'business as usual' this is expected to continue across all consuming sectors, with growth especially pronounced in transport and households.	See recommendations with regard to greenhouse gases and acidification precursors and transport. Potential reduction of energy use in residential sector is much greater than outlined in the climate change strategy (and there are also considerable health benefits (Clinch and Healy, 2001)). The principal initiatives recommended include a clear state-led information campaign combined with grants for low-income households for installing energy-efficiency measures.
3. Agriculture and Forestry	Key challenges are emissions of acid precursors (ammonia), eutrophication of freshwater, nitrification of groundwater, and biodiversity loss. Global warming also an issue.	Tradition of subsidy (victim pays principle) needs to be broken as it increases the number of producers and therefore the overall level of pollution. Including agriculture in greenhouse gas emissions trading will give an incentive for farmers to switch from pollution intensive activity (e.g. by switching to trees or using methane recovery systems). Taxation should be used to encourage farmers to switch from urea to CAN to reduce ammonia emissions. Restructure forestry grants to reflect CO ₂ sequestration as well as other environmental benefits. Compensation for delivered positive externalities such as unique habitat protection should be continued (e.g. via REPS) but should be subjected to Benefit-Cost Analyses.
4. Tourism	Dramatic growth in visitor numbers leading to increase in access transport externalities, congestion, loss of character, and pressure for development of golf courses, hotels, and other tourist related facilities.	Wherever congestion is evident, examine the feasibility of introducing congestion taxes, including charges for access to fragile habitats, islands and 'bed taxes' in congested urban areas.
5. Industry	Rapid growth in industrial output, but nature of industry is relatively 'clean' and controlled.	Investigate potential for least-cost approaches and possible trading of elements of IPC quotas.

Endnotes

1. The original work (Kuznets, 1955) demonstrated a relationship between income growth and income inequality.
2. The literature on the economics of uncertainty is very relevant to this debate.
3. Once any environmental externalities are priced, e.g. using a carbon tax, price premiums or restrictions on the use of exhaustible resources should not be necessary if the market works well, as the price should reflect any potential scarcity and lack of substitutes in the future. In the oil market, this is complicated by the presence of a cartel.
4. See Clinch and Convery (1999) for a relatively short overview of environmental valuation.
5. See Clinch (1999), Clinch (2000) and Clinch and Murphy (2001) for rare examples.
6. I would like to pay tribute to the UCD Urban Institute, COFORD and Owen Keegan (Director of Traffic, Dublin Corporation) for being outliers in this regard!
7. I am delighted to say that my department is co-ordinating a European-funded project on this issue.
8. Unless otherwise stated, the data in this section come from DTO (2000).

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DISCUSSION

Professor David Pearce: Peter Clinch has chosen to address a very demanding subject in his Barrington lecture, and he does it very successfully. The essence of the problem he deals with is the uneasy tension between Ireland's recent and enviable economic growth performance and environmental quality. While many efforts have been made over the past 30 years to deny that growth and the environment are incompatible, the truth is that governments and academics alike have not made a good job of demonstrating that these twin objectives of policy can be secured without significant trade-offs. It is entirely understandable from a political standpoint to deny that there is a trade-off: there are strong electoral pressures for more growth, but there are also loud voices rightly demanding that the quality of life matters. Those voices extend beyond national boundaries, and it is a naïve politician who believes that international opinion is less important than domestic opinion, as President Bush may be beginning to learn. But, faced with apparently conflicting demands there is a temptation to believe in 'win-win' solutions, a temptation all too readily justified by some of the academic and consulting company literature.

Notable has been the corporate responsibility literature which repeatedly suggests that a strong environmental stance will not only improve the environment, but cut costs, improve market share and raise market worth. There is some truth in this suggestion, but not a great deal of truth. Despite the encouraging messages and corporate rhetoric, few corporations are actually engaged in environmental and social responsibility activities. Those that are may certainly have gained a 'first mover' advantage, particularly by currying favour with regulators and government. But the idea that everyone can gain win-win outcomes is not really credible. In the same vein, academics held in high regard, such as Michael Porter in the USA, have suggested that aggressive environmental policies give countries a competitive advantage. But it is a proposition that is hard to demonstrate, though equally hard to falsify as some commentators have noted.¹

Much the same can be said of the popular 'environmental Kuznets curve' which suggests an inverse 'U' shaped curve linking pollution to economic growth. As incomes per capita rise so, after a point, pollution declines because of structural economic change and a rising demand by the electorate for environmental quality. Unfortunately, once efforts to identify such curves went beyond the traditional air pollutants such as sulphur and nitrogen, so it became increasingly difficult to identify such inverted 'U' relationships. Moreover, very recent work has begun to question even the early findings for the traditional pollutants²

As Peter Clinch shows, Ireland's rapid economic changes are causing environmental problems, ranging from difficulties in meeting the Kyoto greenhouse gas target to those of honouring the Protocols to the Convention on the Long Range Transport of Air Pollution. What is missing, he says, is evidence of the 'decoupling' of emissions from economic change. The importance of decoupling, or raising 'resource

productivity' as it is now termed, cannot be overstated. The options facing a country like Ireland are essentially three: continue to grow and face a deteriorating environment; grow and decouple, or not grow. I suggest the last is in fact not an option because what determines long-run growth is not short run government policy but technological change and investment in human capital. The idea that any government would deliberately set out to reduce growth by reducing investment in education, training and R&D is not, I suggest, credible. Hence the options are grow and suffer a reduced quality of life, or grow and decouple. Only the latter is acceptable. But if this is the case then we have to ask how we can decouple environment from growth.

Peter Clinch rightly focuses on market-based instruments such as environmental taxes and tradable permits. We now know that they can greatly stimulate the right kinds of technologies.³ But there has to be an additional focus on incentive measures for environmentally beneficial technology. The dismal state of initiatives to switch all of us out of carbon-dependent technology explains much of what is going on. Even environmental and energy economists have focused too much on taxes rather than payments to bring on new technology such as renewable energy. As my colleague Dennis Anderson has shown repeatedly, there are enormous external benefits to be obtained by jump-starting environmentally sound technology so that movements down very steep learning curves can be secured.⁴

The pursuit of resource productivity is the only acceptable way forward for any environmentally conscious nation. But resource productivity means better and cleaner technology, and better and cleaner technology means a technology policy. No doubt some technological change will just 'happen' but modern theory suggests that most of it is the result of conscious decisions. What a shining example Ireland could set by being the first nation to embed the critical relationship between technology and the environment in its future national plans. Peter Clinch has all too vividly portrayed for us the cost of not doing this.

Endnotes

1. See Michael Porter's work such as "The competitive advantage of nations", *Harvard Business Review*, March/April, 73-95 1990; *The Competitive Advantage of Nations*, Free Press: New York; 1991; "America's green strategy", *Scientific American*, April, p. 168; Porter, M and van der Linde, C. 1995a. "Toward a new conception of the environment-competitiveness relationship", *Journal of Economic Perspectives*, Vol. 9 (4); and Porter, M and van der Linde, C. 1995b. "Green and competitive: ending the stalemate", *Harvard Business Review*, 73, September/October, 120-133. For critiques, see Palmer, K., Oates, W and Portney, P., 1995. "Tightening environmental standards: the benefit-cost or the no-cost paradigm?" *Journal of Economic Perspectives*, 9 (4), 119-132; Smith, V.K and Walsh, R. 2000. "Do painless environmental policies exist?" *Journal of Risk and Uncertainty*, 21, 1, 73-94

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Mr Brian O'Connell: Chevy Chase, one of the more luxurious suburbs surrounding Washington, DC, reputedly has the highest average per capita income in the world. This is where the lawyers, the lobbyists and the most senior American government officials live. And this is where American public policy is set, and solutions for problems such as global warming are formulated.

Less than an hour's drive away is the real world. The state of West Virginia is physically beautiful, but hidden away in its rural backwaters is some of the worst poverty in America. West Virginia is far removed from Chevy Chase. The industrial underbelly of its economy is not hidden away behind leafy suburban housing estates. Factories, coalmines and massive steel works are seen as economic opportunities, not blights on the landscape. West Virginians are not bankers, lawyers and lobbyists. Lucky West Virginians are factory workers, farmers and miners. The unlucky are simply poor.

West Virginia delivers five electoral votes in the U.S. election, and these five votes invariably go to the Democratic candidate. If the state had gone into the Democratic category in the US presidential election, the month long electoral dilemma in Florida would have been irrelevant. Al Gore would have won the election by a margin of one electoral vote, and celebrations would have commenced immediately on the

evening of November 7th. But George Bush beat Al Gore handily in West Virginia, and the issue that swung it for Bush was the Kyoto Protocol, a well intentioned treaty to fight global warming that, if implemented, would have bankrupt the fragile economy of the state.

Thanks to the voters of West Virginia, the Kyoto Protocol is now officially dead, at least in terms of American participation. George Bush made few comments about the treaty during his campaign, except to state that it was potentially an economic folly for the US to reduce its output of greenhouse gases without the participation of developing countries such as China and India. What made the Kyoto Protocol a local issue in West Virginia was down to one person, David Greenstreet, a professor at West Virginia University. Greenstreet was commissioned to formulate a study of the economic impact of the Kyoto Protocol by the state government. His findings revealed that whatever fragile economic advantage the state enjoyed because of its access to cheap coal, and thus cheap power, would be lost if the US ratified the agreement. The high paying jobs at steel mills and aluminium smelters in the northern part of the state would be lost as industry moved out, and the essential mining sector in the southern part of the state would be devastated as the country moved away from coal fired generation.

The findings in Greenstreet's study were exploited by the Republican Party and turned into a very effective local election issue. Gore's well known support for the Kyoto Protocol were what lost him the state, and thus the election. The Kyoto Protocol has not been an issue of public debate in Europe, nor has the economic impact of implementation adequately been studied. But if it were, and the matter became an election issue, it is hard to believe that Europeans would be more altruistic than West Virginians. The problem with selling the Kyoto Protocol to the voters is that opponents can make ratification appear to be economic suicide. It takes a fairly sophisticated electorate to realise that the development of the new technologies to fight global warming, and the actual conservation of energy resources, represent potentially positive economic gains. Selling the Kyoto Protocol to educated voters in California or New York is a lot easier then selling it to factory workers and miners in West Virginia.

The basic flaw with the Kyoto Protocol is that, in implementation, it requires each nation to ration energy, and the most effective way governments can control energy distribution is through taxation. Energy taxation potentially hurts the poorest of the world most, making home heating, hot water and private transportation into luxuries only affordable by the rich. Energy rationing can also directly impact the economy by driving industry offshore.

Stopping global warming is the most important environmental issue of the century, but the battle plan for fighting climate change can not be drawn up by environmentalists. The flaw with the Kyoto Protocol was the entire process was driven by environmentalists who were fundamentally opposed to real solutions, and seemingly hellbent on arresting economic growth in the industrialised world. The

Kyoto Protocol was an agreement that penalised the most successful people of the world, and greatly inhibited the possibility for economic success for those less fortunate.

Any effort to stop global warming must allow for continued economic growth, and the only way for this to occur is to encourage the development of new technologies that allow the world to continue to expand energy use without creating the greenhouse gases that are polluting the atmosphere. These technologies are on the drawing boards now, but their implementation is an anathema to the environmentalists of the world.

There are a number of false solutions to global warming, the most flawed being the conversion from coal fired production of electricity to seemingly high efficiency natural gas generators. Industry and the environmental lobby have long suppressed information concerning the leakage of natural gas from the well head and pipelines, although this leakage can be as high as 7 percent of total delivered fuel. Methane is twenty times more powerful than carbon dioxide as a greenhouse gas, and when leakage is accounted for, the 'greenest' fossil fuel for power generation turns out to be liquid petroleum. Other follies include wind power and biomass, which will never be more than expensive eccentricities.

The only real solutions to global warming are converting power production on a wholesale basis to nuclear generation, the construction of cogeneration plants that more effectively utilise energy and retiring the internal combustion engine for transportation. According to Wood McKenzie, the transportation sector is the fastest growing source for greenhouse gases, and even in the UK increased emissions from the transport sector may make it impossible for the country to meet its emissions goals.

Interestingly enough, France seems to be the only country in the world where environmentalists do not seem to have a problem with the atom. President Bush and Vice President Cheney have pledged as part of their future energy policy to restart the dormant nuclear industry in America, but he will face considerable opposition in this effort. Fortunately, Westinghouse in the US and Eskom in South Africa have developed new types of nuclear reactors that are inherently safe, cheap and quick to build. For the first time since its creation nuclear power will be competitively priced against coal and oil-fired electricity, and the looming risk of proliferation will be eliminated.

Retiring the internal combustion engine will occur within the next decade. Fuel cell powered vehicles, which run on hydrogen, will be cheaper, more reliable and far quieter than the type of cars we now purchase. Companies like Ballard in Vancouver are beginning mass production of fuel cells this year that will be fitted in vehicles for sale in California by the year 2004.

The death of the Kyoto Protocol does not mean the end of the fight against global warming. On the 17th or 18th of this month President Bush will announce the framework for the administration's new energy plan. This plan will not only address the immediate problem of power shortages on the west coast, and the potential of those occurring also along the eastern U.S. coast this summer, but it will also address the notion that the U.S. needs to increase the supply of energy. It will also simultaneously address the issue of climate change. President Bush has convened a task force within the White House and this group has formulated a new government position that addresses the problem.

The New York Times reported on April 28 that the White House has held a number of high-level briefings on global warming since the administration announced in March that it would not propose regulating CO₂ emissions from utilities and that it considered the Kyoto Protocol dead. Regular attendees have included Vice President Cheney, Secretaries Paul O'Neill from Treasury and Spencer Abraham from Energy, EPA Administrator Christine Todd Whitman, and several White House policy staffers. The report by Andrew C. Revkin gives indirect support to rumors that the Bush Administration is considering several proposals to address global warming, including "voluntary" and mandatory cap-and-trade limits on CO₂ emissions. In addition, the administration now apparently plans to bring a "constructive position" to the ongoing Kyoto Protocol negotiations in Bonn in July.

The New York Times claims, *"There is a growing realization at the White House that the blunt rejection of the [Kyoto] treaty may have caused more problems than it solved."* It quoted one senior government official as saying, *"The decisions six weeks ago were made in an appalling vacuum of information. A substantial portion of the people involved wish they had it to do over again. They might still have rejected Kyoto, but probably in a different way."*

"The list of speakers," according to the New York Times, *"has been dominated by scientists and policy experts who believe that a recent global warming trend is at least partly caused by humans, poses risks and requires a significant response to stem the build-up of greenhouse gases in the atmosphere."*

Those briefing the White House included: Dr. Richard S. Lindzen, the Alfred P. Sloan professor of meteorology at the Massachusetts Institute of Technology, Dr. James E. Hansen, a climate modeler with the Goddard Institute for Space Studies, Dr. Daniel L. Albritton, Head of the National Oceanic and Atmospheric Administration's (NOAA) Aeronomy Laboratory, Dr. Richard L. Schmalensee, the dean of the Sloan School of Management at MIT, William K. Reilly, former EPA administrator and current president of the World Wildlife Fund, and Kevin Fay, executive director of the International Climate Change Partnership, an industry front-group that favours Kyoto-style regulations.

There are two key statements the President will make next week:

1. The President believes the science behind the issue and that it is convincing enough to compel some government action.
2. Some sort of internal program of abatement program will be proposed that will not be linked with any international agreement.

One thing President Bush is not going to do is use tax as a tool to address the issue of climate change, although raising the costs of energy through an indirect form of rationing is a form of an indirect taxation.

Funding the development of new technologies that allow the world to reduce its output of greenhouse gases, and still enjoy continued economic growth, is key to the solution of the problem. The U.S. spends about \$5 billion dollars each year funding research into new technologies that have the potential to reduce greenhouse gas emissions.

The framework of the Kyoto Protocol was flawed from the start, and Bush's actions may have been his greatest gift to the world since he took office. Instead of a complex and economically punitive agreement, a far simpler solution would be the imposition of a nominal carbon tax among developed countries, the proceeds of which would be channelled into research and development. The technology which allowed us to utilise fossil fuels are what got us into the problem of global warming in the first place, and technology is what will solve the problem once and for all.

Professor Louis Smith: I would like to congratulate Dr Clinch on his presentation, so much more sophisticated than our work as Barrington lecturers fifty years ago. In doing so, may I make an observation on housing policy?

In the street where I lived most of my life the price of houses has risen to over a thousand times what I paid. There has been a great transfer of wealth to my generation from the young people (and high costs associated with distant housing they must buy). This is not due to any action of the owners and far exceeds any inflation of costs. It is a rent, which, as Classical Economists reasoned, did not enter the cost of production. The way Ireland has treated this surplus has serious effects on our pattern of housing and the demand for transport and infrastructure.

The increase in price is due to the growth of the city, but accrues to the owners. In addition, the sitting tenants have seen the abolition of tax on property in the form of Rates; of Income Tax on the presumed rent; of Capital Gains Tax on most transfers by owner/occupiers. Sale of houses is made cumbersome and expensive. The Corporation, responsible for development, has been deprived of most of its income from Rates and derives no direct income from costly development it undertakes.

Our system has starved urban development of funds; encouraged extravagant housing for tax avoidance; retained older people in inner suburbs, where their

“imputed rent” and capital gains are untaxed. Legal expenses inhibit property transfers when larger family houses become almost empty.

The effect is to reduce the population density in the established suburbs and force the new population to distant and inconvenient locations, which necessitate infrastructure costs and pollution by transport.

Many years ago I was attracted to the Danish system under which the city shared the capital gain due to expansions. Their “perpetual mortgage”, under which the capital borrowed is not repaid, has important advantages. The annual payment is reduced. Occupation of the property is transferred simply by assigning the mortgage and making a cash settlement between the parties. Legal costs and delays are minimal.

Professor Finbarr Bradley: I enjoyed the paper which gives a comprehensive analysis of market instruments available to Government to mitigate the affect of negative impacts of growth on the environment. Did the author not consider that certain institutional arrangements are also available for this purpose? I am thinking specifically of public-private partnerships (PPPs) where if contracts are designed properly, periodic performance payments by the public to the private sector partner can be linked to quality so that state policy *vis-a-vis* quality of life issues can also be implemented.