

*Research Needs of
Sustainable Development¹*

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RESEARCH NEEDS OF SUSTAINABLE DEVELOPMENT¹

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We cannot command nature except by obeying her.

(Francis Bacon)

Preface

The understanding of natural laws underlies the research programme so that we can 'obey nature' and thereby develop in a sustainable way - but let us not forget that human behaviour is part of nature's ways too. Human nature must also be understood. Socio-economic research, which looks into how people are motivated and interact with resources, is essential to help guide behaviour because it is the human activities that are environmentally unsustainable.

INTRODUCTION

Unsustainable activities - Asset degradation and depletion

During the eighties Irish citizens became aware of a particular problem of sustainability. This was at the time when the nation was living beyond its means. Financial assets (our international balance of payments and government budget) were in the red and deteriorating, and it became evident that continuation of such behaviour was impossible. Ireland faced the prospect of growing trade deficits and government borrowing, manifesting themselves in ever higher debt interest and requiring ever higher taxes.

Such unsustainable degradation of assets has its counterpart in the natural world and it is 'unsustainable' in a similar sense. A major difference between the environment and the economy is that environmental problems and solutions are less obvious. The degradation of the environment and its functions is sometimes very gradual. Many people would not make the connection between such everyday activities as leaving equipment switched on and resource depletion or degradation and, ultimately, to reduction in the quality of life.

If the gradual nature and seemingly convoluted inter-connections were not enough to contend with, there is also the underlying problem of externalities and absent markets. These contrast with the 'simple' problems of economic unsustainability of the eighties, where political exploitation of the electorate's failure to grasp the implications of overspending could only last as long as tax rises were acceptable. Tackling environmental unsustainability faces the extra hurdles of scientific understanding on the one hand and the economic circumstances that characterise environmental problems (summed up in terms such as 'market inadequacies') on the other. The research framework for sustainable development therefore has to support scientific knowledge alongside understanding of socio-economic behaviour and market structures.

¹ This document is based on a paper delivered to a workshop on the *Research Needs of Sustainable Development* held by the Environmental Protection Agency on 12th November 2003.

This paper now proceeds in three sections:

- 1 The framework for research
- 2 An overview of recent socio-economic research (by environmental theme)
- 3 Priority research topics (including the gaps in current research).

The last section on priority research topics is based on discussions with many end-users of research. A summary concludes the paper.

I FRAMEWORK FOR RESEARCH

Examples of unsustainable situations

The environmental assets that can be the object of unsustainable use are many and varied. Some examples are given that cover the main types. The earth's atmosphere is an asset of the type that can be degraded by being 'over-used' as a sink. Waterways are similarly vulnerable. Water use without regard for hydrological constraints and the opportunity cost of water (that is its value in competing uses) can not only damage the cycle but harm dependent life. Fisheries are so-called renewable stocks that need to be husbanded. But in the context of common ownership, agreement and policing can be beyond the organising abilities of the communities depending on them. Multi-country organisations could be in a better position to control exploitation if they were independent of sectional pressures, which they are often not.

Constraints on absorptive or absolute capacity are coming into view. In the case of stocks of depletable resources such as natural gas, by definition their use is asset depletion. Here the unsustainable nature of consuming these assets can be stemmed by using the income from depletion to produce other assets, such as the development of backstop technologies for example - these could be fuel replacements, such as solar or wind energy. But what about species loss? Is there ever an argument for losing a species, part of the 'library of life', even if replacement by some other valuable asset follows? And how to compare the values of different assets that, like adding apples and oranges, need a means of being valued? On the other hand is total preservation realistic?

This raises the question as to whether there are environmental assets that are so-called 'critical assets'. With critical assets substitution by other assets is not a realistic option: there are no close substitutes, the loss of the asset would be irreversible and life depends on them. Agreement on these is difficult, not only as to how reversible loss would actually be but as to the importance or value of the asset in the first place. If an asset is considered to be critical then 'strong sustainability' is proposed, that is, policy needs to avoid depletion and substitution. With non-critical assets, 'weak sustainability' is proposed, because allowing depletion and ultimate substitution is considered optimal for human wellbeing.

Are ethics taken into account?

Evidently ethical considerations are raised in this context. The aim of optimising 'human wellbeing' was mentioned, which implies that decisions reflect what society as a group of self-interested individuals wants. This would seem to be at variance with a broader idea of good that goes beyond the interests of humankind, to such ideas of 'intrinsic' worth and rights.

The idea that assets have intrinsic rights suggests that the value to humans should not be the sole yardstick. Yet the specification of intrinsic rights can only be made by humans, whose opinions on the rights to existence of assets will differ from person to person. There is no simple solution to this conundrum except that, in fact, intrinsic values can, should be and often are taken into account in economic analyses, under the heading 'existence value'.

Surveys of individuals' willingness to pay to conserve nature (in contingent valuation exercises for example) elicit not just self-interest but also other attributes, such as 'moral satisfaction' and beliefs in rights to existence and the desire to bequest assets to the next generation. While necessarily anthropocentric, these elicited intrinsic values and the right to exist of natural assets can and are often taken into account. The share of the population 'willing to pay' and the amounts in money terms can be quite low however, though they rise with education and knowledge about nature.²

A standard economic condition

At the root of environmental degradation is the fact that environmental assets belong to no one in particular who could benefit from maintaining them. Because using them brings individual gain, which can be very large indeed, or quite small but enjoyed by a large number of people, it is difficult to prevent over-use. This is like a 'natural' law. It persists as long as potential gain persists - hence the statement "**pollution is an economic problem**". Examples range from the construction company that can spoil a view or habitat, to factories using the air's assimilative capacity, to politicians who can gain by 'giving away' environmental assets. Combine this with the fact that as they become scarcer environmental assets are becoming increasingly valuable, a point that is not obvious because the assets are not marketed, the current environmental degradation that we witness is inevitable and predictable by economists.

In the absence of intervention, the conditions for maximising the efficient use of resources overall are not met. Over-exploitation and too little environmental protection occur. This is a case of where letting the market function in order to maximise efficiency first requires that the conditions be met for the market to do so.

Multi-disciplinary approach

Economic analysis alone cannot usually deal with environmental problems and, in some cases, barely at all. However to go as far as the report on soil degradation that not once mentioned the cost of soil erosion is an example of how economic aspects can easily be overlooked (RCEP, 1994). An editorial in the Journal of the Society for Conservation Biology stated:

"...often...we get the biology right, but our conservation interventions still fail to sustain target species and ecosystems. The disconnect between our biological knowledge and conservation success has led to a growing sense among scientists and practitioners that social factors are often the primary determinants of success of failure."

While absence of markets is the simple explanation, the mere creation of markets is not necessarily the solution. This is because the reason for their not being markets in the first place is a product of features that characterise the environment, which include its diversity, the lack of clear ownership, its diffuse nature, difficulties of monitoring and ease of cheating. It is evident that social, institutional and political issues as well as the more obvious scientific characteristics of the asset in question are likely to require the application of several disciplines.

Research is an important tool for promoting sustainability because it can point to more efficient ways of meeting environmental improvements. That is, it enables less resources to be used. Those costs of environmental protection that the public hesitates to pay for can be reduced and more protection can be bought for the amount spent. Incidentally, research is in turn similarly subject to the 'market' problem that an insufficient amount of it will normally be undertaken, without market intervention in the form of societal support. This is because

² Education, knowledge and values could be analysed from data held by ESRI.

research too is subject to externalities, that is, there are wider benefits from research that do not result in returns to the researchers. Consequently without intervention there will be underfunding relative to levels that would occur if investors in research were to enjoy these additional social benefits. A research programme funded through and overseen by the EPA is particularly appropriate.

Policy makers are often in a difficult position because pressure groups, doing their job, can be powerful and mount a persuasive case. It is important to distinguish between pressure **groups** and seriously disadvantaged **victims** of the policy. The institutions involved in policy are **many** and include the Department of Finance (including the Green Tax Group and the NDP/CSF Evaluation Unit), DEHLG, DSCFA, LA, EPA, the research community and NGOs to name a few. It is evidently difficult for some of these to adopt a **long term** outlook and not be subject to restricted by their disciplines and outlooks. That Ireland recently went through the biggest investment boom in its history without a spatial strategy and with scant use of the guiding hand of economic instruments is a lost opportunity. The magnitude of loss will only become apparent as relatively expensive retro-fit has to be implemented. The investments that IPC or local authority licensing could not reach are now solidly instated in inappropriate infrastructure, machines and lifestyles.

II REVIEW OF RECENT SOCIO-ECONOMICS RESEARCH

This review now describes some socio-economic work that has been undertaken and it groups the work according to the environmental themes:

- Climate change and greenhouse gases
- Eutrophication of waters
- Waste and litter
- The urban environment and transport
- Protection of natural resources

It summarises consultations with many of the main researchers in this area, conducted for a review for the EPA. For reasons of space a comprehensive review was not possible.

• Climate change and greenhouse gases;

Four studies are summarised here that looked at policies to address greenhouse gas emissions and a fifth project is about to start. Four of the studies look at carbon taxes and one looks at a programme of home insulation.

In an ongoing study funded by the EPA, Fitz Gerald *et al* (2004) have developed the ESRI's macro-economic model of Ireland to assess both the effects of introducing changes in taxes on carbon dioxide emitting fuels and of introducing a carbon emissions trading regime. This framework is used to forecast emissions out to 2015 and to examine the macro-effects of different strategies to reduce Ireland's emissions. Results indicate that the best strategy would be to use a carbon tax or auctioned emissions permits and to use the bulk of the resulting revenue to reduce taxes on labour. Around a quarter of the revenue, if set aside, could be used to deal with the adverse effects on low-income households.

In a related study, Scott and Eakins (2004) use the 1999-2000 Household Budget Survey to see how the introduction of a carbon tax would affect different households. The aim is to avert fuel poverty by means of various compensation strategies. Availing of the revenue set aside for this purpose, as stated above, various methods of targeting vulnerable families are described. Some 90 per cent of households in the lower half of the income scale can be targeted for compensation under existing social and fiscal procedures. A possible

compensation strategy is outlined and the *net* effects of the reform are presented, enabling the gainers and losers to be identified. Some 84 per cent of targetable households in decile 1 would be net gainers, and 72 per cent of households in decile 5. Other supporting measures to help losers and ease the transition to carbon taxes are also described.

The implication for sustainability of research into tax policies, such as this, is that tax policies promote emissions abatement using least resources overall. This is because under a tax system those who can abate cheaply (i.e. using least resources) do most abatement.

In a study commissioned by IBEC, the harmful effects of carbon taxes on the competitiveness of energy intensive industries were described (Boyle, 2000). Sectors accounting for nearly 30 per cent of employment would be affected according to the study (not taking recycling of the revenues to reduce other taxes into account). The authors recognise that 'there is a role for an energy tax... as part of a wider package of measures and only if it is carefully designed'. Further research that differentiated between those industries that are and those that are not exposed to international competition is evidently needed. Investigation of potential sensitive application of carbon taxes and the scope for long-term adaptation could receive more attention, not to mention the recycling of revenues, not covered in the IBEC study though earlier covered by O'Donoghue (1997).

The ESRI is part of consortium that will undertake an *ex post* analysis, called COMETR, of the competitiveness effects of environmental tax reforms. This would address the concerns highlighted above. The study is being commissioned by the European Commission under the Sixth Framework Programme for Research. Countries that have undertaken green tax shifts include: Denmark, Norway, Sweden, Finland, the Netherlands, the UK and Germany.

A cost-benefit study was undertaken of improved energy efficiency in housing by a research team including the Environmental Institute (Brophy *et al*, 1999). This study had to resort to valuations of environmental improvements largely derived from abroad, though some results were available from the ExternE study on the external costs imposed by fuel cycles, in which the Environmental Institute had previously participated. The cost-benefit analysis indicated that benefits of investing in energy efficiency were on balance positive and that therefore some state support would be justified. The nature of the support was not described in detail but difficulties were noted arising from the spread of responsibility for policy in this field over 10 departments and agencies. The importance of institutional arrangements is underlined by this finding as well as the need to address concerns about enabling the work of relevant bodies to be integrated.

- **Eutrophication of inland waters;**

Five studies are described, two that investigate pricing for sustainability (waste water treatment and fertiliser use), one relating use of water services to costs and one assessing an anaerobic waste digester for treating animal wastes in sensitive catchments.

Research under this topic by the ESRI has produced a pricing procedure that aims to achieve good standards of industrial discharges to water at minimum capital cost (Scott and Lawlor, 1994/7). By pre-announcing the capital charge for treating pollutants, the waste water treatment authorities can give firms the correct price signals. Firms can then take decisions on the basis of costs, which reflect scale and location. This work has proved to be a useful guide to some waste water authorities who have said that they rely on it; further work on the costs of pollution abatement at the margin would be useful.

The costs of investment in water schemes, financed by the Cohesion Funds, have been analysed and the costs have been compared with available information on the benefits that have ensued from the investments (DKM/ESRI/Aquavarra, 2004). This work has pointed to (a) gaps in fundamental data such as data on water-based use including angling, (b) a lack of

work on valuation of non-marketed benefits so that foreign valuations have to be avoided of, and (c) absence of prerequisite procedures for monitoring outcomes of projects. The aim of such work is to show how benefits of investment compare with costs, to ensure money is well spent and thereby provide managerial information on efficient options for pollution abatement.

A study supported under the EPA's ERTDI programme has been undertaken by the ESRI (Scott, 2004 forthcoming) to address fertiliser use. The aim is to investigate the feasibility of applying a tax that would ideally only be borne by those farmers who applied more fertiliser than warranted by conditions on their land. An important contribution to dealing with the problem would be for major purchasers of nutrients to provide information on their nutrient inputs and outputs, and a method for achieving this by means of the VAT system is investigated.

A pilot exercise by the ESRI for EUROSTAT has assembled the EPA data on discharges to water and classified them for use in economic analysis. This followed work on environmental accounts for the Central Statistics Office. For different industrial sectors, the amounts of discharges are given expressed per unit of output or per person employed. This should facilitate industrial benchmarking for comparing the polluting potential per euro of output from different sectors. The work also combines national data on expenditure and revenues and hence on cost recovery of the water services sector. While the data situation is unsatisfactory, it is evident that the statutory surveys undertaken by the Central Statistics Office could be valuable sources of information alongside the system of data assembly introduced by DEHLG.

A brief financial and economic assessment of a centralised anaerobic digester for treating animal wastes in sensitive catchment areas was undertaken by Curtis and Scott (2001). While requiring a subsidy towards the capital costs, the proposed digester's costs and benefits might just about even out when environmental externalities are taken into account. One of the main shortcomings of the study was its need to rely on *valuations* derived abroad of water quality improvements, which is an anachronism given the sizeable programme of expenditure devoted to water quality improvement in Ireland.

- **Waste and litter;**

The most comprehensive study of the economic dimensions of solid waste management was published by the ESRI in 1995 (Barrett and Lawlor, 1995). In this study, the costs of the various approaches to disposing solid waste were analysed. In addition to the direct financial costs, an effort was made to factor in an estimate of the environmental costs. A study, under the EPA's ERTDI programme, that considers the possible effects of volume-based and weight-based charging is also underway and will incorporate data from a charging scheme, when the data become available.

Barrett and Lawlor (1996) went on to consider the issue of siting landfills, proposing that compensation be used as part of the siting process. Charges for solid waste services were further reviewed by Lawlor (1996). He conducted a number of case studies and gave a tentative assessment of the impacts of charging, subject to the limited data available. Reeves and Barrow (2000) have studied the collection side of solid waste services. Their particular focus was on the cost savings that were achieved by local authorities that contracted out their collection services.

- **The urban environment and transport;**

Goodbody Consultants and the ESRI (led by Oscar-Faber) undertook a wide-ranging analysis of the effects of transport growth and impacts on the environment. The summary of the unpublished report is available on the website of the Department of Public Enterprise. The report pointed to continuing growth in transport and emissions of greenhouse gases. Where

local pollutants were concerned, the prospect for reductions was rather better owing to new technologies, though urban locations could still be vulnerable. The need to target fiscal measures was described, so that motorists, providers of public transport and car commuters were not faced with misleading or mistimed incentives that encourage behaviour that perpetuates the problems. Directions for the adjustment of fiscal measures were outlined and these could be usefully expanded. Valuations of environmental degradation that had been derived abroad had to be used.

In a road-use pricing trial by TCD's Engineering Department, the resulting different reductions in car use at peak time and off-peak time reflected the different pricing levels assigned. The trials gave a 22 per cent reduction in car use in the peak period and they could be an indication of the impact in a situation where road use pricing really operated. This work is being expanded in the current ERTDI programme of the EPA.

UCD's study called *Greenspace* looks at the public benefits of greenspace in urban areas, and is developing a method for determining the mix of greenspace types that best meets people's needs. The project engages in 'choice experiments', a subset of environmental evaluation techniques and an alternative to Contingency Valuation Methods. Choice experiments have also been used in the UK and in Scandinavia.

- **Protection of natural resources.**

Included under this heading are studies of forests, fisheries and urban wildlife. In the most comprehensive assessment of the economic value of the afforestation programme, Clinch (1999) places monetary values on each of the costs and benefits - values that were subsequently useful for other studies investigating the case for environmental protection. Costs and benefits consist of biodiversity impacts and landscape effects as well as timber, inputs, carbon sequestration, effects on water, recreation and tourism. The author discusses how the subsidies could be more strongly focused to reward and encourage desirable outcomes.

Landscape was addressed by the Renewable Energy Strategy Group (*Strategy for Intensifying Wind Energy Deployment*). So that soundly based decisions could be taken, the study made the suggestion that lands be zoned according to well-researched criteria into areas where the acceptability of wind generation would be given, (zoned broadly into 'yes', 'no' and 'make-your-case').

On the subject of fisheries, assessment of the profitability of different fishing fleet segments in off-shore fishing has been undertaken (Curtis *et al* 2001). This project considers both economic and biological information in assessing the economic state of the fishery, though it is not a full bio-economic model and therefore does not throw light on the overall setting of quotas. Another study by Curtis (2003) indicates that Irish rivers, wetlands, estuaries and seas are highly valued, while there is some evidence of social exclusion in water-based leisure activity.

Other work of a methodological nature has been undertaken by Curtis (2001) on the subject of wildlife (suburban deer population in Maryland). The work elucidates the nature of public opinion, the policies that people favoured or found difficult to accept, and assessed the benefits and costs of several management instruments.

This review so far has summarised some of the economics research that can be classified under the heading of 'challenges' listed in the EPA's *Millennium Report*. As was seen a shortcoming in economics research in Ireland is that, where valuations of environmental assets are required, foreign valuations usually have to be resorted to. Commissioning of work in this crucial area has not been forthcoming with the small exception of some recent tasks,

even in relation to water quality improvements where there has been a very large programme of expenditure.

Where there is a forum for policy discussion, research can be helped to bear fruit, especially if the forum can operate in a context of continuity and independence. Lack of continuity has been a serious problem for researchers dependent on commissioned work. Fortunately a forum has been available in the research network on the environment under the Concerted Action Programme, coordinated by Professor Frank Convery at the request of DGXII of the EC. A series of books on tools for environmental policy under the general editorship of Convery has been published by Edward Elgar under the heading *International Studies in Environmental Policy Making*. The network acted as a supportive focal point for socio-economic researchers. In a project called *Green and Bear It?* the ESRI along with Professor David Pearce and authors from the OECD pursued issues arising from the perceived problems with implementation of economic instruments. Despite the difficult research climate, such fora have kept open the agenda and provided encouragement to Ireland's economists working on the environment to persist in researching questions that were at the core of sustainable development.

III PRIORITY RESEARCH TOPICS

Gaps in current research and top priority topics

We now turn to priority research topics in socio-economics. Research addresses questions and in writing this paper some end-users of research were asked what they perceived the gaps to be. The categorisation used below falls into four types, along the lines of the needs communicated to us.

End-users of socio-economic research on the environment include the EPA, the Department of the Environment, Heritage and Local Government, the Evaluation Unit of the National Development Programme/Community Support Framework (NDP/CSF), the 'Green Tax' group of the Department of Finance, Sustainable Energy Ireland (formerly the Irish Energy Centre), Local Authorities (the County and City Managers' Association) and Dublin City Council traffic department, NGOs and the European Commission, to name but a few. There is an interest in seeing that the work described below is done, and the priority topics described emanate directly or indirectly from potential users.

Needs of users can be grouped into the following sorts of requests:

- (1) investment appraisals or cost-benefit/cost effectiveness analyses,
- (2) information on policy instruments and the options for economic instruments in particular,
- (3) models to investigate wider choices and outcomes, and
- (4) information in the nature of what should be held in a well maintained research base.

Each of these types of request is now looked at in turn.

(1) Cost-benefit/cost effectiveness analyses and investment appraisal

Integration of development with the environment is at the heart of environmental policy. Development directly or indirectly entails investment, which once installed, predetermines resource and environmental impact for many years to come. Inappropriate choices can be doubly costly (1) by being opportunities foregone and (2) by requiring expensive retrofit later. Therefore the full costs and benefits of alternative policy choices ought to be assessed at the outset. This is in addition to the requirement for financial analyses. Areas mentioned as candidates for cost-benefit analysis were water quality, road-building, tourism, energy, waste

management and agriculture. The potential for exploiting economies of scale, in waste water treatment and in solid waste facilities for example, needs to be clearly assessed.

Where **water quality** is concerned a major question is the environmental effectiveness of present and future levels of treatment and their types and, also important, the other options for achieving environmental quality. Our knowledge is poor on what combination of policy instruments - negotiated agreements, taxes and charges, regulation, public and private investment, improved information - is likely to deliver desired objectives, in ways that are economically efficient and technically and administratively feasible.

This points to the need for more attention to be paid to evaluation of costs and benefits. The appraisal manual of the CSF Evaluation Unit, for example, contains a paragraph describing how external effects ought to be taken into the calculations, but it is evident that the prerequisite research here has not been undertaken. The end-users wanted to have estimates of such things as the value that people put on clean rivers and lakes with fish, as so much public money is being spent on them. In the absence of these estimates, 'engineering' results of the project are measured and stated, and the environmental externalities are left unvalued or else have to be valued by the 'benefits transfer' method. This involves taking valuations from studies undertaken elsewhere, an approach that has to be applied with caution and with all assumptions spelt out.

On the large issue of **road building**, research users felt that aspects such as intrusion and damage or fragmentation of habitats were left unvalued and virtually ignored. It was considered that both the physical science as well as the economic science called for more attention. The lack of assessments of environmental costs and benefits was perceived by some who were contacted as endangering the environment. To take an example, in relation to Pollardstown Fen, the financial costs can be estimated but there are two major unknowns. One is the range of potential physical, hydrological, effects on the Fen of sinking the road (a potential cost). The other is the net economic value of noise reduction (a benefit), by virtue of the road being sunk.

There is now a well established methodology for looking at the cost people place on such things as noise and the value they place on **habitats and ecosystems**. In the above case, the valuation of habitats and ecosystems would need to be assessed on behalf of the national population rather than just the population of Kildare. At present we have little idea of how people value environmental assets, though some work shows that valuation is low. There are other emerging indications, however, that level of education attained is associated with higher valuation which, given the changing educational profile in Ireland, could have profound effects on attitudes in the near future (Clinch *et al.* 2000). Analysis of education and its effects on attitude formation could also help to inform policies that aim to raise awareness.

Missing in relation to **transport** is information on the relationship of **settlement patterns** and traffic, emissions and environmental services. Settlement patterns and rural social viability, particularly where villages are concerned, are important areas where the balance between dispersion and concentration needs to be carefully struck. Planning laws and rural renewal incentives need regular assessment in terms of their effects: are more and longer journeys being promoted when all current policies are taken together? The options for increasing the density of development in urban areas have not been subject to economic appraisal nor the combination of policy instruments that are likely to yield desired outcomes. Similarly the land-use and car-use impacts of the programme of road-building are little known. Work on focused cost-benefit analysis of transport was stated to be desirable, with more fundamental understanding of the interaction between roads and the environment. Policies to address **urban air quality** and particulates also need assessment.

Tourism was considered to be another area needing attention because it is the environment that gives Ireland a competitive advantage for this important industry. By the time traffic, urbanisation and industrial and agricultural pollution are noticeable ‘it will be too late’, we were told. A method for establishing monitoring mechanisms in important destinations to look at the impact of tourism on natural resources was favoured, along with investigation of effective peak time pricing systems for tourism assets and environmental services. The destruction of habitats to make way for golf courses is an example of competing land use which has been given inadequate attention. The value of **eco-systems** to the economy has been unmeasured and neglected. The conservation of buildings and streetscapes of distinction is being addressed by a combination of listing, planning requirements, relatively small conservation grants and tax concessions. How much is this costing and will this mix achieve the objectives?

In the area of **energy/air emissions/landscape**, it is seen as an anachronism that measures to promote renewables are more pronounced than measures to promote energy efficiency. Is it cost effective for the state to promote windmills more than user-friendly thermostats and meters? Research on several of these questions could also come under heading 2, policy instruments. In relation to landscape, it would be helpful to set up, soon, the framework for undertaking before-and-after studies of windmill installations, taking into consideration the asset value of landscape and its use in attracting tourists. The issue of siting windmills as ‘onto scenes by Paul Henry’, has been inadequately addressed, as were matters of zoning (mentioned above) including the possibility of siting on spent bogs, and the issue of consultation.

In the field of agriculture, **REPS** was perceived by several of the bodies consulted as requiring more examination. The question posed is what are the aims of REPS and is REPS an efficient means to achieve the aims. An ERTDI project is investigating the environmental outputs which will be useful for appraising REPS, which was introduced in 1994. It was considered that the benefits and costs of the scheme needed to be compared, with valuation required of the benefits, by Contingent Valuation Method or otherwise. On the subject of agriculture and afforestation, the loss of angling and tourism occasioned by these sectors was also described as an issue.

(2) Policy instruments

With growing acceptance of the polluter pays principle, it is important to have an idea of the level of tax or charge that is warranted. **Valuations** of the ‘damage’ by pollution (or benefits to be gained) would also help to raise the acceptability of taxes (or subsidies). The Water Framework Directive for example will in the long-term require environmental damage costs to be charged, in addition to current and capital operating costs. Valuations not only help to justify the tax in people’s minds but also to ensure that the level of tax is not set too high or low, by reference to the damage done.³ River basin planning is an emerging administrative mechanism, also required by the Directive, that has large benefits but where the costs of implementation (monitoring and transactions costs) could be high. There is a need to examine the costs and benefits of alternative **river basin mechanisms**, in the light of experience elsewhere and our circumstances, before decisions are taken.

The ESRI book, *The Fiscal System and the Polluter Pays Principle*, proceeding sector-by-sector, pointed to many research needs surrounding economic instruments (Barrett, Lawlor and Scott 1997, Scott and Feeney 1998). Investigation of the barriers to an **environmentally friendly fiscal system** needs ongoing attention and so do the measures that are needed to overcome these barriers. The removal of domestic water charges in 1996 shows how serious those barriers are. The barriers arise from several causes and sections of society. The

³ This should be marginal damage cost at the optimum.

environmental effects of all fiscal measures and policies impinging on the environment need to be analysed and each year the **Budget** could be systematically checked for its environmental effects.

In relation to agriculture, again, the book suggests that besides analysis of regulations and subsidies, such as REPS, there is scope for experimenting with competitive tendering. Farmers could be invited to tender for farm-based projects that provide **biodiversity**, including rare breeds, and habitats. Because farmers with most appropriate conditions are likely to be most interested, competitive tendering holds out the potential to achieve more protection for money spent. A trial scheme could be set up and analysed. It is increasingly apparent that organic food production needs to be reassessed in the light of the potential opportunities offered by current concerns over foods. With current talk of including aviation in the Kyoto regime, the cost of air transport could rise. This in itself could help domestic organic production, though not as much as under a regime of carbon taxes in which some of the revenues could be used to promote organic production. Policy instruments, such as subsidies to cleaner production, as against or combined with taxes on polluting production methods, need investigation. Likewise, because of our relatively large afforestation programme, **carbon sequestration** will assume higher importance. The policy mix, practicalities, effects and effectiveness need assessment. In relation to wildlife, is the policy mix mobilised by the Habitats Directive likely to achieve the objectives?

Waste water **charges** need further investigation. They vary across the country in unexplained ways and the rationale for future charging patterns ought to be elaborated as will eventually be required under the Water Framework Directive. Other costs arising in the future are those that may be incurred by global warming, including perhaps rising sea levels. Given the concentration of human settlements around **the coast**, with 80 per cent of people living within 10 km of the sea, it could be worth considering how to deal with the costs that could arise.

Research on **waste management** should investigate the development of landfill and incinerators and the implications of the economic gains from large size, as well as the issues of composting and recycling from the point of view of the individual. Waste management involves the behaviour of every member of society, and understanding why people dispose of their waste in the way that they do is critical to developing waste management policy. Research on preferences for type, size, location and other factors relating to landfill and incinerators would facilitate both local authorities and private companies in developing infrastructure. On the issue of **litter** in particular, much expenditure and effort, in the form of wardens, legislation, media advertising campaigns, bins, posters etc. have been devoted to reducing litter generation. What are the options, the policy instruments, their costs and effectiveness? Insights drawing from *ex post* analysis of Irish and international experience could help guide policy in a manner that would help funds to be spent cost-effectively.

In relation to **transport** the research to date on refocusing of taxes, such as VRT, and the fiscal treatment of heavy goods vehicles needs to be advanced to look into remaining areas of uncertainty, such as the sectoral effects. There is the problem that urban sprawl could negate technical advances. Irish studies could additionally help to inform the negotiating position in Brussels on transport (fuel taxes, HGVs, VAT and so forth) so that it is based on evidence. Analysis of **inner city** congestion and pollution and solutions such as road-use pricing now has the advantage of a live experiment applied to London. Analysis can be pushed further by looking at combinations of bases for road-use charging, such as distance, time or a combination of these, and at other policies, including parking policies. Analysis of behavioural responses to taxation policies and distributional impact, not just rich versus poor but rural versus urban impacts deserve attention

A final issue under the heading of policy instruments is **distributional impacts**, which arises frequently, as seen. An objection to road-use charging, for instance, was found to be that it

could be 'unfair to the less well-off'. It is important to investigate the effects on vulnerable sections, and on low-income households especially in order to look at means of mitigating the impacts on them, as was undertaken for carbon taxes (Combat Poverty, 2003; Scott, 2004). The social welfare system can well manage the compensation for changes if there is forward planning, *vis.* the smokeless fuel allowance, but changes need to be carefully specified and the best methods of alleviating hardship need to be investigated.

(3) Modelling

Models enable one to link the environment with the macro-level and provide useful insights as to economy-wide effects, where these apply.

One type of model, a Computable General Equilibrium Model (CGE), is probably more suited to international studies such as the OECD Green Model. There is scope however for linking environmental issues to existing macro-models such as was done by using the ESRI's HERMES model to analyse the carbon tax and to assess the options for recycling the revenues: be it by reduction of debt, PRSI reduction, VAT reduction and so forth. There is also scope for looking at the macro effects of a proposed **set of fiscal measures or a programme of reform**, rather than just one tax.

The possibility should also be examined of linking sectoral models to environmental issues. Examples are **agriculture** and fisheries. Work on the model of the agricultural sector developed by Teagasc to link **alternative land uses** with environmental impacts should be expanded. Agriculture's role in the areas of water pollution and greenhouse gas emissions points to those areas being priorities for research. The inclusion of **forestry** as a possible use allows simulation of the effects of shifts of policy that alter the relative attractiveness of pasture and forestry.

Modelling in the **fisheries** sector is not well developed in Ireland, but it should be possible to link on-going studies of sea and inland fisheries with environmental issues. Examples would include the effects of eutrophication on recreational fishery values, of over-exploitation of species on harvesting communities and the economic and social implications of aquaculture and its environmental effects.

Analyses of trans-boundary pollution may come under this heading, including analysis of policies in support of the Gothenburg Strategy. There are some trade-offs requiring examination.

(4) The economics research base, including maintaining the data base.

The research base includes the types of research that need to be ongoing, or periodically updated. This will include prerequisites such as the ongoing assembly and presentation of data, and in particular the updating of elasticities (which measure the all-important response to price and income change), shadow prices and marginal abatement costs, to name a few.

As was evident above, there are continuing calls for valuations of use and non-use of environmental assets. Areas where the lack of valuations was felt included housing conditions, rivers and lakes, waste management facilities, damage deriving from transport growth, habitats, eco-systems, to name the few that arose in this exercise alone. A regular trawl should be made of all the major **valuations** from abroad that could be needed by studies here. The most urgent need for Irish valuations was perceived to be in the areas of threatened eco-systems. Valuations of clean water, lakes with fish, landscape and aesthetic features were also seen as helpful to make eco-taxes more acceptable and to provide values for investment appraisals and cost-benefit analyses. Credible quantification and valuation of transport congestion was also seen as necessary to give policy selection a solid basis. In some areas it

was felt that foreign values could be transferred to the Irish case, though exercises in this so-called ‘benefits transfer’ require caution to be exercised. The over-riding aim should be to improve our capacity to analyse on the basis of evidence in order to make informed policy choices.

Calculations of **elasticities** of, for example, energy demand in Ireland have been undertaken and are available for use (Conniffe 1990). However there need to be regular updates, as new data emerge, such as the Household Budget Survey. If more detailed calculations of elasticities could be produced, the expected impacts of economic instruments could be assessed with greater certainty.

These are items that ought to be to hand and need regular updating. A ‘well-maintained’ research base would have the added advantage of being able to produce answers more quickly. Furthermore, opportunities can arise for enhancing valuable linkages (for example, by the longitudinal study of children and the house condition survey). As in the past, environmental modules can be appended to such surveys, at reasonable cost, provided there are the foresight and resources. Working in an uncertain funding environment, researchers are not in a position to devote the time to specifying such modules and thereby opportunities to enhance the research base are foregone.

A fair section of research papers seem to be taken up with repetitive descriptions (possibly on foot of costly search) of how the data were not available. In the context of the changes in the environment wrought by investment under the National Development Plan, a routine system for collecting data on physical environmental effects of the NDP should be established as recommended in the evaluation of the eco-audit of the NDP/CSF 2000-2006 (Scott *et al*, 2003). Data from the EPA, such as that derived from the IPPC licences, should be converted to NACE categories for incorporation with CSO’s data series. Data synergies need to be exploited. Presentation of key information such as trees felled, hedges removed, severance imposed, green areas concreted over, should be put on a systematic footing. This needs to go hand in hand with the development of Environmental Impact Assessment and Strategic Environmental Assessment (EIA and SEA). In countries such as Canada, which has a strong commitment to the environment, there is a matching high-level commitment to an **environmental-economic data** programme, which was placed in the National Accounts and Environment Division of Statistics Canada. This would be equivalent to the Irish Central Statistics Office having environmental data allied to the National Accounts section.

Integration of the environment into national economic accounting frameworks can also come under this heading of the research base. **Greening of the national accounts** needs to start with recording depletion of resources and could progress to further refinements (Scott, Nolan and Fahey, 1996). Issues such as whether GNP and GDP are really growing, to the extent that people feel better off on balance, could be debated. Indicators of what is happening need to be constantly assessed in case their underlying assumptions need to be changed. In particular it would also be important to measure whether sustainability is or is not being promoted by the fiscal and pricing system. What is the extent of perverse subsidies? How well does the fiscal system deal with externalities? Sustainability would be well-served by such measurement. Life-cycle information is also needed to help in the search for options and sustainable recycling.

Final items included under the heading of Research Base include regular assessment of society’s **preferences** between options, properly spelt out. The democratic process does not always promote debate that correctly spells out implications. Well-considered investigations of preferences subject to realistic choices, would help to raise debate to a more informed level. Acceptability of various measures and their combinations, the various approaches abroad and at home need investigation (e.g. to motorists’ taxes).

IV SUMMARY OF RESEARCH NEEDED FOR POLICY ON SUSTAINABLE DEVELOPMENT

Degrading one's assets would seem to be a strange phenomenon. But when one considers what the assets in question are, namely the environment and its varied functions of source, sink, life support and welfare functions and with their characteristics of common ownership, complexity and non-excludability, degradation is not unexpected. To economists, these characteristics spell trouble for the asset and they require special policies to prevent degradation. This applies virtually across the environmental board.

This paper has considered socio-economic research⁴ to address the issue of sustainable development and the list of priorities is based on consultations with the end-users of environmental economics research.

The research areas noted include **valuations** of environmental quality of various sorts. In particular, the 'use' values and 'non-use' or 'existence' values of habitats, biodiversity, wilderness areas, eco-systems, the quality of water in rivers and lakes and urban quality, are regularly required. Investment in roads and water, where large expenditures are being incurred, call for valuations in areas affected by these programmes. In some areas foreign valuations can be used but generally as a second best and only with caution.

Cost-benefit or cost-effectiveness **appraisals** are called for in areas including water quality improvement, tourism, transport, urban quality and promotion of energy efficiency and renewables. Analysis of **policy instruments** is needed, particularly in terms of their mix, their actual implementation and their effects on distribution and competitiveness and means of mitigation. Schemes to promote environmentally friendly agriculture and habitat protection are seen as priorities for assessment.

The potential for continuing the integration of the environment into agricultural, regional and macro **models**, and the scope for incorporating other sectors such as fisheries, forestry, water, deserves consideration.

The research **base** should include up-to-date estimation of elasticities, marginal abatement costs as well as assessment of attitudes to the environment and their formulation. It is also important that fundamental data bases be constructed and maintained. These would include data on leisure uses of the environment, such as fishing, which are needed for applying valuations. These tasks need dedicated regular attention.

The research base ought also to include ongoing assessment of how well sustainability is or is not being promoted by the fiscal and pricing system. It could address vital questions such as: What progress is there on removal of perverse subsidies?" How far has cost recovery progressed (which is a requirement of the Water Framework Directive in the area of water services)? How far are the critical externalities being dealt with in the fiscal and charging systems? Sustainability would be well-served by regular clarification of incentives.

While it has proved convenient here for purposes of presentation to separate studies under the headings 'cost-benefit', 'policy instruments', 'modelling' and 'research base', the distinctions are inexact and studies usually entail working under several headings. It is noted that many

⁴ Research relating to social and economic issues has been discussed, though research in the field of sociology is not covered.

past studies have gained by being multi-disciplinary in character and it needs to be borne in mind that the laws of economics are the laws of nature too.

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