**Chapter 6**
**ENERGY**

By S. Scott, in “The fiscal system and the polluter pays principle - a case study of Ireland”, published by Edward Elgar.

## 6.1 Environmental Impact of the Sector

The energy sector affects the environment in its production, transportation, transformation, use and residue-disposal phases. Here we will concentrate mainly on those aspects for which damage costs have been estimated and which are the main cause of concern in Europe. They are also highlighted in the report of Ireland's EPA, *State of the Environment in Ireland*. These relate to the transformation and use phases and include the emissions of carbon dioxide ($CO_2$), which constitutes about half of the Global Warming Gases, sulphur dioxide ($SO_2$) and nitrogen oxides ($NO_x$), the last two being implicated in respiratory problems and acid rain.

Global warming is a potentially serious issue for Ireland. The increased emissions of large quantities of so-called greenhouse gases, that trap solar heat radiation and prevent it escaping back to space, can lead to an increase in global temperatures. Given the wide natural variations in temperatures over the centuries, it is difficult to detect change and attribute it to the release of greenhouse gases. The recent report of the Intergovernmental Panel on Climate Change (IPCC, 1996) states, however, that studies have detected a significant change and show that the observed warming trend is unlikely to be entirely natural in origin, and that the balance of evidence suggests that there is a discernable human influence on global climate.

It is not clear to what extent Ireland would be affected by global warming. Higher temperatures and a rise in sea level of a few centimetres may not impose heavy costs, in terms of inland water depletion et cetera. However, the possibility of extreme climate changes in either direction, (a climate in Dublin like that of Spitzbergen in Norway is one prediction, in Scientific American (1995)), the small possibility of a spiralling effect, as warming leads to accelerated release of gases, and the existence of long lead-times - are a spur to take precautions and restrain growth in emissions. In fact Ireland's emissions, at perhaps 0.1 per cent of world emissions, have a negligible effect; but non-cooperation is not an option. Apart from the fact that Ireland would like many other nations to co-operate, the Environment Council's (1996) objective is for significant overall reductions of greenhouse gas emissions after 2000 to below 1990 levels. Ireland's agreed target for 2000 of stabilising emissions at 20 per cent above their 1990 level looks set to be met, while the target after 2000 is currently under negotiation and may be more restricting. Even in the absence of global warming, there would be no regrets at having reduced emissions, in so far as the costs of reduction are less than the cost of damage inflicted by emissions.

Several attempts have been made to measure the potential costs of climate change induced by man's release of greenhouse gases. These studies focus on what is expected to happen if the level of $CO_2$ in the atmosphere doubled compared to its pre-industrial level. The IPCC's earlier study estimated that such changes would cause a rise in global annual mean temperature of 2.5$^{o}$C, with a range of 1.5$^{o}$C to 4.5$^{o}$C, and melting ice, which would raise the sea level by between 15 to 120 centimetres up to 2100.

Estimates of the costs of damage resulting from such climate changes have been made, based on extrapolated expected damage costs in the US. They are shown in Table 6.1, for illustrative purposes. While estimated climate effects have been revised downwards by the IPCC and these costs are clearly unrepresentative of other regions, they give some values to go on. Differences between the figures are largely accounted for by a higher figure being given to the value of a human life in some studies.

Table 6.1: *Estimates of Average Global Damage Costs in the US Resulting from a Doubling of $CO_2$ Emissions.*

| **Study** | **Damage cost Billion 1988 US$** | **Damage cost % of GDP** | **Average unit damage cost 1988 ECU/tC** |
|---|---|---|---|
| Fankhauser (1993) | 250 | 1.5% | 17 (range:5 to 40) |
| Nordhaus (1991) | 220 | 1.3% | 15 |
| Tol (1993) | 415 | 2.5% | 28 |

*Source:* DRI (1994). *Note:* tC = tonnes of carbon. One tonne of carbon emitted forms 3.6667 tonnes of carbon dioxide.

As can be seen from the table, estimates of the costs of damage arising from $CO_2$ emissions range from 5 to 40 ECU/tC, or £4 to £32/tC (where tC is tonnes of carbon). It is noted that the carbon part of the EU's proposed carbon tax, discussed later, falls within this range.

We now turn our attention to the other two emissions, $SO_2$ and $NO_x$. There is concern about these, especially on the European mainland. They have harmful effects on health, crops, building materials and monuments, forestry (see the forestry section in chapter 4), on water in lakes and rivers, visibility (smog) and nature. Estimates of the damage to the first four items, health, crops, building materials and forestry are shown here in Table 6.2, aggregated by DRI

(1994) into costs of damage per tonne deposited. These relate to the three countries for which estimates have been made, namely West Germany, the Netherlands and the UK.

Table 6.2: *Aggregated Costs of Damage of $SO_2$ and $NO_x$ Deposited, in ECU/t*

| | **West Germany** | **Netherlands** | **UK** |
|---|---|---|---|
| **$SO_2$** | 1202 to 3605 | 1062 to 3185 | 745 to 2234 |
| **$NO_x$** | 683 to 2049 | 762 to 2286 | 394 to 1181 |

*Note:* Only damage to health, crops, building materials and forestry are considered.
*Source:* DRI (1994).

Again, these figures are highly preliminary and could be altered by an order of magnitude. In the case of Ireland, the effects of sulphur deposition are not all negative, since it can benefit some crops. However some areas in Ireland are vulnerable to acidification; waterways for example may be under threat, which are not covered in the above estimates. $NO_x$ on the other hand is becoming more of a problem in urban areas despite increased use of catalytic converters, owing to a rising number of vehicles.

Armed with these foreign valuations of partial damage costs per tonne, and with knowledge of the emissions per tonne of each type of fuel, it is possible to calculate the damage costs per TOE of fuel consumed, shown in Table 6.3. TOE stands for tonnes of oil equivalent, a common measure of calorific content to which all fuels can be converted. (1 TOE = $10^7$ kilocalories.)

Table 6.3: *Emissions in t/TOE and Damage Costs in £/TOE, for Main Fuels*

| | $CO_2$ | | $SO_2$ | | $NO_x$ | | Sum of damage costs |
|---|---|---|---|---|---|---|---|
| | t/TOE | £/TOE | t/TOE | £/TOE | t/TOE | £/TOE | £/TOE |
| Peat | 4.34 | 4.73-37.88 | .0126 | 7.51-22.52 | .0042 | 1.32-3.97 | 13.56-64.37 |
| Coal | 3.70 | 4.04-32.29 | .0241* | 14.36-43.07 | .0021 | .66-1.98 | 19.06-77.34 |
| Oil | 3.01 | 3.28-26.27 | .0059 | 3.52-10.54 | .0021 | .66-1.98 | 7.46-38.79 |
| Gas | 2.07 | 2.26-18.07 | 0 | 0 | .0021 | .66-1.98 | 2.92-20.05 |

*Sources:* Emissions/TOE: McGettigan (1993), Scott (1992). Damage costs/tonne: Tables 6.1 and 6.2. above. Note that the lowest damage costs in Table 6.2 have been used, which relate to the UK. £1=1.25 ECU. t/TOE = tonnes per TOE.

*Notes:* For information, the EU's proposed carbon tax has (1) a carbon component at $5/barrel of oil = £23.38/TOE of oil = £27.37/tC = £7.47/t$CO_2$, and (2) an energy component of £23.38/TOE for any fuel, except renewables, including hydroelectricity, as used in Fitz Gerald and McCoy (1992). Hydroelectricity is to be charged because it would be difficult to isolate and exclude from the charge.
*Lower if desulphurisation equipment is operating.

These figures for external damage costs of various fuels are shown here, because they give us an idea, and no more, for the sorts of costs that are envisaged. In theory then, according to Table 6.3, application of the Polluter Pays Principle implies that peat and coal be quite heavily taxed, even if only the carbon dioxide is considered to be the pollutant, and that oil and particularly gas be taxed somewhat less.

We said at the start of this chapter that we would only be dealing with the main aspects of the transformation and use phases of the energy sector. This is not to imply that production, transportation and disposal of residue are not matters of concern, or indeed that emissions of $CO_2$, $SO_2$ and $NO_x$ are the only environmental effects of transformation and use. Intrusion on views and impacts on habitats by power stations and windmills are a case in point. There is also some disquiet at the extent and manner of turf extraction in certain areas in Ireland and at its damage to scenery, ecosystems and species. The value of this damage has not been assessed. Turf cutting localities are, on the one hand, appreciated for their intrinsic value and depicted in art and poetry and, on the other hand, rejected as representing a hard and unrewarding life, such that any valuation would need to be mindful of this range of view. A similar kind of range of view was accounted for in Norway in the evaluation of bears in the chapter on agriculture (Navrud op. cit.), where people who wanted them exterminated were also represented. Even after taking these precautions in valuations, the problem remains that perceptions are evolving quite rapidly with changing circumstances, as evidenced, for example, by growing support for organisations which aim to arrest the damage to ecosystems and scenery.[1] This is not to mention growing international concern for threatened ecosystems, displayed for example by willingness-to-pay on the part of individuals in the Netherlands to preserve a few unspoilt Irish bogs.

Transportation of oil is another important area not covered here, though oil spills have serious environmental impacts. A study of the effect of coast guard monitoring was recently undertaken to establish the extent to which increased monitoring resulted in reduced oil spills (Viladrich-Grau, 1994). The study seemingly indicated that increased monitoring resulted in increased oil

[1] The number of people giving financial support through donations or membership to the Irish Peatland Conservation Council, for example, has more than trebled since 1991.

spills. In other words, it showed that detection had previously not been very thorough. In sum, good mechanisms are needed for monitoring as well as for determining blame, apportioning costs and enforcing payment for clearing up oil spills. These need to be formulated in international fora in such a way that the incentives are right, in the face of much uncertainty concerning the weather, carelessness, human error and equipment failure. The final consumer ultimately pays to finance the mechanism, such as it is, but payment in the first round should be made by the potential polluter, the oil transporting companies, if the Polluter Pays Principle is to apply. At present the victims, the uncompensated inhabitants of affected coastal areas, pay a share.

### 6.2 Existing Fiscal Treatment of Energy

The excise duties on transport fuels are not covered here as they are discussed in the chapter on transport. That chapter describes how in aggregate motorists pay for a large share of the costs that they impose, though not specifically *as* they impose them, and not sufficiently in cities. Therefore this chapter is concerned with non-transport fuels, meaning that jet fuel, petroleum and diesel oil are largely ignored here.

The most striking feature about the fiscal treatment is the reduced rate of VAT applied to heating fuel and light, at 12.5 percent, a "reduced rate" which is allowed in the harmonised EU VAT rules. The incongruity is compounded by the high rate of VAT which is imposed on insulation materials which are charged at the standard 21 per cent. An energy audit is also charged at 21 per cent. Energy conservation work, of the nature of building repair and maintenance, is also charged at 21 per cent if the materials are more than 2/3 of the total cost. Only if labour constitutes a third or more can the work be charged at the building, repair and maintenance rate of 12.5 per cent VAT. This might in fact be the majority of jobs, since energy conservation work tends to be labour intensive. The UK has a similar situation, with energy charged at 8 per cent and conservation materials charged at 17.5 per cent. The intention in the UK to raise VAT on energy to 17.5 per cent was ineptly handled, not being accompanied by a corresponding rise in social welfare payments, so that such a move is deemed politically unacceptable for the near future. In Ireland, reduction of VAT on conservation materials would bring some consistency to the situation. However a general uniform rate of VAT was recommended by the Commission on Taxation (1984) and harmonisation by Article 99 of the EU Treaty (European Communities, 1992). Therefore, in order merely to level the incentives, the reduced rate on fuel would need to be raised to the standard rate. It is recommended that discrimination, if necessary, be on the basis of explicit subsidies or grants.

At present there are two main grant schemes in operation in Ireland which aim to encourage energy conservation. These are (1) the Energy Audit Scheme and (2) the Energy Efficiency Investment Support Scheme, both administered by the Irish Energy Centre. They are available to organisations including industrial firms, commercial organisations, educational institutes, public sector organisations and local authorities. The objective of the schemes, which are funded by the EU, is to reduce national energy consumption and promote energy efficiency.
The Energy Audit Grant Scheme provides grant assistance, up to a maximum of £5000, to organisations that engage independent consultants to carry out site energy audits and surveys. The energy audit assesses how effectively and efficiently a company controls its energy costs. If approved, a grant of up to 40 per cent is available towards the cost (excluding VAT which is charged at 21 per cent) of conducting an energy audit. The audit will identify the potential for energy and money savings and will recommend energy saving actions, many of which may be costless or low cost. Other actions "with longer paybacks" may be eligible for support under the second grant scheme.

The second grant scheme, the Energy Efficiency Investment Support Scheme, provides grant assistance, up to a maximum of £100 000, to organisations which propose to invest in technically proven energy conservation technologies or measures. Two of the criteria for approval are noted: one is that the project have potential for widespread replication in other organisations, another is that "simple payback times (without grant support) must be realistically short". When there are investment opportunities with short payback periods, it implies that they have good internal rates of return or net present values. If individuals and organisations do not avail of seemingly good opportunities facing them, there is said to be market failure. Market failure can occur when there is ignorance about the investment and its potential benefits, where there are hidden costs, credit constraints and, perhaps, where the potential benefits are rather small anyway or very uncertain, or where behaviour is irrational. One suspects that the first two apply in the organisations targeted by the schemes funded by the Irish Energy Centre, namely ignorance and hidden costs. In so far as ignorance plays a role, it would be of benefit for the schemes to get feedback from persons working on the premises and ascertain their levels of understanding, attitudes and behaviour, with a view to rectifying these if necessary. In the nature of things, recipients of grants will have less commitment than people who paid for energy conservation measures themselves, and the benefits of technical improvements could easily be whittled away by adverse behaviour. It would also be desirable for there to be more firms offering energy conservation services, to present more competition in the supply. There should also be analyses of the before and after situation, to see whether schemes were effective.

Subsidies are made available to charitable bodies, such as Energy Action, to enable them to undertake insulation work on dwellings of low-income households. The organisation also trains 25 unemployed people each year to UK "City and Guilds" certification levels in house insulation. Lawlor's (1995) analysis of this scheme, which insulated approximately 1200 homes in the year 1993/4 at a cost of £232 000 to the government, reveals an internal rate of return of between 29 and 39 per cent (depending on labour cost assumptions), plus training skills, plus 344 tonnes of $CO_2$ saved annually.

Finally there may be subsidies aimed at non-energy objectives which have the effect of lowering price and perversely encouraging energy consumption. Such activities are sometimes not overt. The sort of activities which fall into this category would include the award of grants to private turf cutters, or charging fuel used as feedstock at a price that is below the world price.

## 6.3 Options Based on Information from Ireland and Abroad

### *6.3.1 Indirect Taxes*

VAT rates on fuel tend to be higher elsewhere than in Ireland. For gas and heating oil, Ireland has the fourth lowest rate, at 12.5 per cent, in EU member states, after Luxembourg, Britain and Italy, six countries charging at 20 per cent or over. For electricity, Ireland has the fifth lowest VAT rate, with Portugal imposing a 5 per cent rate. Significantly however, the UK charges only 8 per cent and may not make another attempt at raising it for a while.

The rate of VAT applied to heating fuels and lighting could be raised from 12.5 per cent to 21 per cent. However with a quarter of households receiving social welfare payments, compensation for the VAT rise would entail diverting some 20 per cent of the increased revenue to raising social welfare payments. This would enable low-income homes to be no worse off. Personal expenditure in 1995 on fuel and power was £862 million (from Table 13 of CSO, 1996). The rise in VAT rate would yield some £65 million in increased revenue, of which £52 million would be net of funds diverted to compensate social welfare recipients. To put it in context, the extra £52 million represents over $1^3/_4$ per cent of total VAT revenue and could be used to reduce the standard rate of VAT. The 7.6 per cent fuel price rise resulting from the imposition of VAT could be expected to reduce[2] consumption and revenue by about $2^1/_4$ per cent in the short term and over $4^1/_2$ per cent in the longer term, reducing the rise in VAT revenue to around £45 million after compensation.

[2] These reductions are based on the information on responsiveness of energy demand to price changes, derived from studies by Conniffe and Scott (1990) and Scott (1991).

Existing excise taxes tend to be viewed as revenue raisers, rather than as a means for internalising an external cost imposed on the rest of society. Ireland has, again, the fifth lowest rate of excise duty on home heating oil, after Belgium, Luxembourg, the UK and Finland (European Commission, 1995). Some countries levy carbon taxes on top of existing excises on fossil fuels. Table 6.4 is a summary of carbon taxes levied abroad.

Table 6.4: *Explicit and Implicit Carbon Taxes Levied Abroad.*

| Country | Rate per tonne of $CO_2$ | Implicit Rate of Existing Excise Duty | Incentive | |
|---|---|---|---|---|
| | $ECU/tCO_2$ | $ECU/tCO_2$ | Intended | Actual |
| Denmark | 5.5 (industry)<br>11.1 (households) | 26.3 | + | .. |
| Finland | 2.2 | 19.1 | # | .. |
| Italy | 1.7 (fuels producing thermal energy) | 39.9 | .. | .. |
| Netherlands | 1.6<br>(excl feedstocks) | 15.9 | - | .. |
| Norway | 13.8-40.6 (many special allowances) | 32.5 | + | .. |
| Sweden | 9.5 (industry)<br>37.9 (households) | 38.2 | + | # |

*Notes:* + = yes - = no .. = no data available # = unclear
*Source:* OECD (1994) p. 73.

As the above table shows, energy and $CO_2$ taxation are high in Sweden, to such an extent that some district heating plants are changing from fossil fuels to bio fuels.

Charges are raised on the sulphur content of fuels in Norway and in Sweden, as described by OECD (1994, p.74). The Norwegian charge is levied on oil and the Swedish charge is levied on oil, coal and peat. The charges are intended to be incentives to switch to low sulphur fuels and activities, and the revenues accrue to the general budget.

The Norwegian charge is levied per 0.025 S-weight percentage (S-weight is the share of sulphur in the weight of the fuel) at a rate of ECU 0.008/ litre of oil. It is not levied on oil with sulphur content lower than 0.05 per cent. The Swedish charge is levied per 0.1 per cent S-weight at a rate of ECU 3.2 per $m^3$ of diesel fuel and heating oil, and ECU 3.6 per kg for coal, coke and peat. An evaluation of the Swedish sulphur tax indicates that sulphur content of oil used has decreased by around 30 per cent, and emissions from burning coal and peat have also decreased considerably. The tax has made it profitable to clean flue gases to a larger degree than before. Administrative costs are probably less than 1 per cent of revenue. Repayment of the tax occurs if actual reductions of $SO_2$ emissions are demonstrated, and this occurs on a rather large scale. The success of the tax has resulted in an unexpected revenue shortfall. Finland has also imposed a sulphur tax towards the end of 1993.

In addition, Sweden has imposed a charge on $NO_x$, the incentive effect of which has surpassed all expectations. In 1992 the emission reduction was between 30 to 40 per cent compared to an expected reduction of 20 to 25 per cent. The charge is raised on $NO_x$ emissions of energy producers at a rate of ECU 4.7 per kg of $NO_2$. Small installations are not subject to the charge as the fixed cost of metering would be excessive and only final energy producers are charged. If emissions are not actually measured, standard emission rates apply which exceed what might be paid under the measured charge, encouraging the installation of measurement equipment. Charge revenues are in fact rebated on the basis of final energy production of installations, such that the total impact is zero, but with redistribution between high emitting and low emitting plants

A tax on $SO_2$ in Ireland could be considered, in order to reduce emissions from households and small industries, which constitute about a third of emissions. The remainder is covered by quotas (discussed below) under the Large Combustion Plant (LCP) Directive. Much sulphur is emitted from high stacks, so that sulphur emissions tend to travel. Only 40 per cent of sulphur deposition in Ireland can be attributed to national emissions, and 40 per cent to other countries, the UK in particular (1996). The tax could be added to the carbon tax. Coal being a high emitter of $SO_2$ and featuring prominently in the budgets of low-income households, compensation would be necessary. Unlike releases of $SO_2$, which are mobile across boundaries, the damage from $NO_x$ is more localised, with nearly a half arising from vehicles. With the growth in transport, the national quota for emissions may be overshot unless action is taken. A $NO_x$ tax could be imposed. If levied at the rate of tax in Sweden (ECU 4.7/kg $NO_2$), revenue from taxing fuels other than those in Large Combustion Plants would amount to some £280 million. If charged at the lowest damage cost given in Table 6.2, revenue would amount to some £30 million. Vehicles fitted with catalytic converters, however, are low emitters and their fuel ought not to be taxed, but it may be unduly complicated to distinguish between vehicles which do and do not have converters. Therefore it may be more sensible to encourage the adoption of catylic converters in the manner discussed in the chapter on transport.

### *6.3.2 The EU's carbon tax proposals*

The EU's carbon tax proposal of 1991, already referred to in chapter 3, has been analysed by Fitz Gerald and McCoy (1992) to estimate its effects in the event of it being implemented in Ireland. The proposed tax, to be applied as an excise tax in stages, was $10 per barrel of oil, with half this amount being applied to the carbon content of the fuel and the remaining half to the energy content of the fuel. This works out at £27.37 per tonne of carbon contained in the fuel plus £23.38 per TOE for the energy component (using the exchange rates of September 1991). It is notable that the tax is not inconsistent with the estimated total damage costs which we saw in Table 6.3, albeit that the estimation of damage costs probably overstates damage to health in Ireland from sulphur deposition, but then omits damage to lakes and rivers. The tax on oil and gas might be rather high and that on coal and turf rather low. In the context of the Polluter Pays Principle, the EU's proposed carbon tax is far from unreasonable. If polluters are imposing these costs and victims are bearing them, there is a good argument for shifting this burden from the victim to the polluter. It would remove the lack of incentive to changes in behaviour and give encouragement to new technology, with less need for subsidies.

Despite having these commendable features, the tax in its original form has not been agreed and may be replaced by minimum excise taxes on fuels. Depending on the rates of excise taxes, the ultimate effects could be broadly similar to the effects of the carbon tax, and governments will still presumably be able to choose how to spend the revenues.

Using the ESRI's Medium Term Model (Hermes), Fitz Gerald and McCoy looked at the implications of the carbon tax for various options as to what the government might do with the revenue. The results of the simulation which assumes that the revenue from the carbon tax is used to reduce Pay-Related Social Insurance (PRSI) contributions, are quoted in Box 6.1. In this simulation it is assumed that Ireland unilaterally introduces the carbon tax. In summary, the results show the carbon taxes yielding an annual revenue of £460 million in year 1, rising to £740 million by year 10, which, on being used to reduce labour taxes (PRSI), increases employment, reduces emigration, has a minor effect on inflation and causes a small volume rise in GNP. Expenditure on fuel and power by manufacturing industries is less than 2 per cent of their total turnover. Therefore industry would be a net beneficiary, being quite a low energy user but a major employer of labour. Hence the compensation to industry in the form of reduced labour taxes outweighs its payment of carbon taxes.

Such a tax would stimulate the search for fuel economies. The power sector would be stimulated to strive for higher efficiencies. Heat recovery would receive a boost as would district heating schemes. Though the price rises would not be so high as they were during the oil price hikes of the 1970s, fuel efficient domestic appliances and vehicle mileage per litre would become the focus of attention again as they did then. The difference here is that the extra payments would not be leaving the country, and could be used to reduce the cost of employing labour.

Industry's gain from the carbon tax would be at the expense of households, which pay the tax and do not receive compensation. However households receive compensation indirectly through extra employment and lower emigration. The effect on households is to add about 1.5 per cent to the household budget, on average, unless they reduce energy consumption, which

**Box 6.1:** ***Results for Ireland of EU's Carbon Tax with Reductions in PRSI Contributions.***

The revenues from the tax are assumed to be used by the government to reduce the level of social insurance contributions (PRSI), which at present add to labour costs. The key to the impact of the revenue switch from labour to energy lies in where the incidence of the tax changes falls: who in reality pays the tax? In the case of energy taxes, because the industrial sector is not very energy intensive, it ends up paying a relatively small share of the tax. This happens in spite of the fact that industry cannot recoup the cost of the tax by raising prices. On the other hand, industry is a big employer of labour and, as a result, it would be a major beneficiary from a reduction in labour costs arising from lower social insurance contributions.

This switch in the tax burden from labour to energy would have a positive impact on the Irish economy. It is hardly a surprising result, given that Ireland is a net importer of energy, its industry is not very energy intensive, and it has high taxes on labour, a factor in excess supply. The net effect of restructuring the tax system is to improve the competitiveness of the industrial sector. Firstly there is some shifting of tax burden away from that sector to services or households. Secondly, because the elasticity of demand for labour is greater than that for energy in the medium-term, it is to be expected that the deadweight losses associated with the tax system would be reduced.

The change in relative factor prices results in higher employment and a limited fall in energy demand and $CO_2$ emissions of about 2.7 per cent. The improved competitive position of the sector leads to increased industrial output and exports and the benefits of the reduction in social insurance contributions are shared between employers and employees.

*Source:* Fitz Gerald and McCoy (1992)

they can possibly do at a profit already by taking energy-saving measures. The carbon tax would make energy conservation more profitable. Low-income households however would be relatively adversely affected by the carbon tax which could add 2.5 per cent to their household budget. It is recommended that some of the revenue be diverted to give compensation via social welfare payments and Family Income Supplement (Scott 1992, 1996). The estimate of the reduction in carbon dioxide emissions resulting from the tax is not quite 3 per cent. This may seem rather small, the authors having taken care to base the estimated results on conservative response rates backed up by available empirical work. It is to be noted that the economy would benefit.

The point must be stressed that a regulatory approach would aggravate the economy by imposing high, if disguised, costs. Similarly the subsidy approach on its own imposes costs on taxpayers, who are to some extent the victims of the polluters' activities. In view of experience from abroad, such as from Sweden's sulphur tax described above, the estimates of the resulting reductions in emissions are conservative and should be viewed as the minimum reductions in carbon dioxide.

Along with other studies (eg Capros 1996), an analysis by the Norwegian Green Tax Commission (Moe 1996) produces similar results to those for Ireland. The Commission calculated the effects of implementing green taxes of some 1 per cent of GDP combined with a reduction in payroll taxes of 2.3 per cent, over time, such that net government revenues are unchanged. The study again showed that both the economy and the environment benefit.

### *6.3.3 Tradable pollution permits*

Turning to an alternative market-based approach, there is some experience abroad with the use of tradable pollution permits. They are also advocated by DRI as the best route for reducing $SO_2$ and $NO_x$ emissions in Europe. As already discussed in the chapter on economic instruments, such a method has the advantage that the desired reduction is achieved, the authorities do not need to know anything about the technical costs of abatement and, provided that there is sufficient monitoring to prevent cheating and that an unhindered trade in permits develops, a given level of abatement is achieved at minimum cost to society. Permits have an advantage over pollution taxes, when increases in pollution are likely to give rise to damage with steeply rising cost, that is when the marginal damage costs curve is relatively steep.

There are several examples of tradable permits in operation in Australia, Canada, Germany and the USA, described by OECD (1994). Tradable permit systems have been functioning in the

USA since 1976. Initially, regulatory standards were laid down there on an emission-point basis, but later flexibility was afforded by allowing trade within a defined area or "bubble". New enterprises aiming to locate in such areas could buy permits off the existing permit holders, as an "offset". "Netting" exempts modifications of existing sources from certain new standards, so long as no significant net increase in emissions occurs with a facility. "Banking" enables firms to store permits for future use.

The offset and netting facilities have been extensively utilized, but most trade has been intra-plant, due in fact to the way that the trading system was only launched effectively after compliance deadlines for the previous regulatory approach. In February 1993 the US EPA issued proposed Economic Incentive Program Rules which expand upon the previous options for emissions trading.

As stated, compared with charges, permit trading has the advantage of a more certain reduction in emissions. However there is a requirement for enforcement which may be less easy than simply adding a pollution tax to an existing tax, for example. An information system is also needed to obtain data on potential buyers and sellers of permits and there has to be an agreed auction procedure. There needs to be agreement on the initial allocation of permits, because it amounts to a bestowal of income, and a clear definition of what is being traded. For example in the case of greenhouse gases, it could be fossil $CO_2$ emissions (total or just energy-related), or net $CO_2$ emissions, equivalent $CO_2$ including other gases, et cetera. It is important to have many operators in the market for permits, such that market power is reasonably shared. This might be a difficulty with international trading if permits are concentrated in the hands of a few countries. One solution to this is to limit the period during which emission permits can be hoarded, though in itself, such a limit would restrict trade.

In Ireland's case, trading of permits in $SO_2$ and $NO_x$ should be allowed within the island at least. Quotas have been allocated to Northern Ireland and the Republic. A subset of emissions has to comply with the levels specified in the Large Combustion Plant (LCP) Directive. The Republic is adhering to its national quotas, except possibly in the case of $NO_x$, where the increase in the number of vehicles is counteracting the increased number with catalytic converters. In fact quota transfer occurs at present but not by being traded. Britain recently transferred 17,000 tonnes of $SO_2$ and 1,000 tonnes of $NO_x$ to the existing quotas for Northern Ireland of 64,000 $tSO_2$ and 20,000 $tNO_x$, at zero price.

#### *6.3.4 Subsidies*

Because pollution taxes and tradable quotas entail adjustments, countries have recognised that to smooth their introduction it is necessary to provide encouragement in the form of subsidies. One such example from abroad, which combines some useful features, is the scheme for encouraging people to install compact fluorescent light bulbs. These bulbs embody a new technology which is demonstrated to be worthwhile. However customers may be unaware of this. By buying CFL bulbs in bulk and with economies of scale in administration, the Energy Savings Trust in the UK sold 1.6 million bulbs in 1994. These normally cost £15 in the shops but, subsidised via the scheme and owing to administrative efficiency, they sell for £10, and save electricity which is worth £33.50 in present value terms. This saving does not include environmental benefits which make it even more worthwhile. The scheme also subsidises purchases by other categories of households to a higher extent. On account of improved market penetration, the free-market selling price has subsequently dropped from £15 to about £12.

Lawlor (1995) has undertaken a study of the costs and benefits of previous subsidy schemes for energy conservation projects in Ireland. The study also looked at pilot energy conservation projects in public sector office buildings and hospitals. The pilot project in a certain public building, undertaken in 1990 and 1991, effected savings of 23 per cent in the building's energy costs, despite the fact that the building was constructed as recently as the 1980s and was considered quite energy efficient at the time. The project entailed replacement of light fittings, installation of lighting controls and conversion from oil to natural gas central heating. Total costs were £56 000, private net present value is estimated at £82 000 with a 28 per cent private internal rate of return. Public benefits would include the reduction of 360 tonnes of $CO_2$ per year, which, for the sake of argument and based on the damage costs in Table 6.1, amounts to annual damage reduction of between £400 and £3100. In the other pilot project of energy conservation in a hospital, savings of 70 per cent of energy costs were achieved. Much of the saving arose in conversion from turf and oil to natural gas. Future savings may not be so dramatic - in keeping with the fact that marginal pollution abatement costs rise.

The main constraint preventing public bodies from availing of such efficiency investments is the inability to borrow. This forces them to undertake only those conservation measures with a short payback such as can be financed from annual energy and maintenance budgets. Furthermore savings made were subsequently absorbed by central government which constituted a further disincentive. In addition the scarce time of management and staff should probably be included as a cost; at least it would appear to be a restricting factor. Recent changes in budgeting procedures, whereby administrative budgets are set for three year periods, may see some improvement. Even then such artificial constraints on efficiency investments are short on justification if a high but drawn out financial return is denied. The Irish Energy Centre Grant schemes could address this problem, though grants might not be necessary if the underlying constraints were addressed.

Lawlor found a similarly large private net present value arising in the Attic Insulation Grant Scheme of 1980 to 1982, with an internal rate of return of 28 per cent. Expenditure of £7.5 million was incurred to which grants contributed £2.4 million. Not being targeted at low-income homes, many grant recipients would have been able to avail of these profitable investments without grants. The public benefit consisted of the reductions in emissions, which again using the damage costs above to give an idea of magnitudes, amounts to between £0.2 and £1.1 million annually. This public external benefit is the component that could justify awarding subsidies if one were pursuing the subsidy option. The net present value of such sums, assuming 5 per cent discount rate and a twenty year horizon, is £2 million to £12 million. The actual grant of £2.4 million at least fell within this range and, being at the lower end of the range, implies that this was a good investment.

In general, assessment of whether to award grants needs to take account of evidence which suggests that the total financial (including private) and external benefits arising should be considerably more than the nominal funds (Honohan, 1996). As stated, scrutiny is especially required where there are relatively large private gains from energy efficiency investments. It may be better to inform people about how to help themselves.

### *6.3.5 Grading the options*

Having described the fiscal system and its consequences and having discussed a few options based on information from Ireland and abroad it is worth noting the results of a study which grades a selection of carbon reducing technologies. The list of technologies covered is very limited but it grades the few that have been addressed, in terms of cost per unit reduction of $CO_2$ (Fitz Gerald and Johnston 1996). The graded costs, starting with the cheapest option, are shown in Table 6.5.

Table 6.5: *Cost of Reducing $CO_2$ Emissions with Different Technologies*

| | Cost per tonne of $CO_2$ reduced, £ | Total tonnes of $CO_2$ which could be avoided |
|---|---|---|
| Energy conservation | Saves money | not avail. |
| Carbon tax replacing PRSI | Saves money | 800 000 |
| Redirect Afforestation | | |

| | | |
|---|---|---|
| grants | 0 | not avail. |
| Electricity generation: | | |
| Gas replacing peat | -24.6 | 1 600 000 |
| Wind replacing peat | -1.7 | 900 000 |
| Wind replacing gas | 41.3 | 300 000 |
| Biomass replacing peat | 63.5 | 2 500 000 |
| Biomass replacing gas | 228.8 | 900 000 |

*Source:* Fitz Gerald and Johnston (1996), p 25.

The grading suggests that it is worth devoting attention to promoting (1) worthwhile energy conservation, (2) a carbon tax which replaces PRSI, (3) afforestation redirected from peat soils[3] to mineral soils, (4) electricity generation by gas replacing peat and (5) electricity generation by wind replacing peat generation. Well over three million tonnes are avoided at no financial cost to society as a whole.[4] There may however be environmental costs which are not included here, such as the placing of windmills or forests in scenic areas. As the table shows, an energy tax, similar to the carbon tax, should play a central role.

*6.3.5 Low-income households*

An important consideration is how would low-income households be affected by a carbon tax. Low-income homes would have characteristics requiring special attention. They are less in a position to borrow to finance efficiency investments and they are likely to take any improvements to the insulation of their homes in the form of extra comfort rather than as energy savings. Their homes tend to have few conservation measures (unless they are local authority homes built since the building regulations were upgraded) so that there would be high potential savings, except that they use very little energy anyway in most cases. Indeed some 15 per cent suffer hardship on a cold day (Callan et al., 1989). They also tend to use the more polluting fuels, coal and peat, for space heating in winter. A disproportionate number of them describe themselves as not being "energy conscious" and mistakenly would buy double glazing as a priority conservation measure, given the opportunity (Scott, 1996).

[3] Described in the chapter on agriculture and forestry. The EU-funded programme of afforestation should be directed away from acid-sensitive soils where there is some uncertainty as to whether the carbon sequestration by the forest compensates for the carbon losses resulting from oxidation of the peat during the development phase.

[4] In other words, part of the nation's marginal abatement schedule, as shown in Figure 3.3 of Chapter 3, lies below the horizontal axis until pollution *reduction* has reached a certain level - a reduction of three million tonnes of $CO_2$ at least.

In the absence of action there is the prospect of further inefficiency if these households become well off without undertaking remedial measures to their homes. For the present however they are trapped into inefficient polluting fuels in poorly insulated houses. Investment is the only route to improvement. The lesson from the UK is that the regressive effect of increased fuel taxes on low-income homes needs to be demonstrably avoidable, by means of raised social welfare payments. Meanwhile in Ireland, the state pays out some £60 million annually in fuel allowances. In theory it would be possible for the state to use part of this to insulate homes, the home being level financially with its "before insulation" situation owing to fuel saved. In practice, the household will spend 60 per cent of the potential for savings on increased comfort, since "comfort" is now cheaper, so the home would be warmer and healthier. Also in practice it would be difficult for the government to remove the fuel allowances, though potential for compromise may exist, whereby people could opt to switch their fuel allowances to payment for efficiency improvements.

### *6.3.6 Behaviour and the market*

A theme which reoccurs in discussions of energy conservation and grants is the enigma of seemingly irrational behaviour. Why should taxpayers subsidise energy users to install energy efficient technology (eg low-energy light bulbs and insulation) and reap a private gain, which if they were rational they would undertake anyway? Many investments in conservation have good net present values. In an attempt to prise an explanation from survey data, it is found that there are sound, though probably not insuperable, barriers to undertaking these profitable investments (Scott 1997). An important reason is found to be lack of information, with respondents saying that they "don't know enough about it" or "don't think it saves money in the long run", referring to clear money-savers, such as attic insulation, hot water cylinder insulation and low-energy light bulbs. High education levels are associated with high probability of ownership of energy saving items, as such people would be in a position to find out about energy efficiency more easily. Rented premises are less likely to have these items and it would not pay tenants to install them, unless they are permanent or long-term tenants. In the case of rented accommodation, regulation is required, or guidelines should be produced for negotiations between the tenant and owner to install energy saving items. A dominant requirement however is unambiguous information about the savings potential, and clear information on how to set about acquiring energy efficiency investments, because people are not aware that this is a better investment than many other investments that they undertake in their daily lives.

A final word in relation to economic instruments is in order. Economic instruments require a potential market situation to exist. This means that people have to be able to act in a manner which improves their perceived wellbeing. There has to be a free market with absence of monopoly elements, alternatives have to exist and people must be aware of them and of other relevant information. A simple but very beneficial recent move was the change by Bord Gais, the gas company, from charging per therm to charging per unit (ie per kWh). People could then observe that the price of gas was about half that of electricity. After taking efficiencies into account the price is still about 30 per cent lower. These are the aspects of information which are difficult for the ordinary customer to know. Another good move is the availability of pre-paid cards for electricity, like telephone cards. Any developments that encourage understanding of the amount of fuel used would be helpful, such as accessible positioning of meters, and bills that are easily understood. Similarly information on pollution from different fuels should be more accessible, with a selection of some of the more relevant magnitudes listed in Appendix 6.1 being presented in some user-friendly manner. Knowledge as to which fuels might be more polluting and how one's behaviour can have an effect is rather scant.

It should not need to be said that any vestigial subsidies to fossil fuel production ought to be phased out. There still exist damaging subsidies in some energy sectors in Europe, not to mention non-OECD countries. The French nuclear industry, for example, is suspected of operating cross-subsidies, given the obscurity of its accounts, and of not internalising the end-of-life plant costs, thereby incurring criticism by the International Energy Agency (Economist, 1996). A critical view should be taken here of pricing and subsidies which obscure the environmental implications of different choices of fuels, such as peat.

## 6.4 Suggested Use of Economic Instruments

A package of tax changes is required to bring some logic to the VAT rates which, as we saw, stand at 12.5 per cent on heating fuels and 21 per cent on conservation materials. There is an argument for setting rates the same on all goods and services so that ultimately the standard rate can be reduced to a lower level. While it might be beneficial to reduce VAT on energy conservation materials to 12.5 per cent, this conflicts with the aim of harmonised rates. However, in so far as sales of conservation materials are not yet in a position to reap scale economies, some boost to sales would be in order which encouraged competition and efficiency. In these circumstances explicit subsidies are preferable and the amounts would be small. The same applies in relation to energy audits.

The rate of VAT applied to heating fuels and lighting should be raised from 12.5 per cent to 21 per cent. Households receiving social welfare payments would need to be compensated for the VAT rise by diverting some 20 per cent of the increased revenue to raising social welfare payments. The net extra revenue of around £45 million could be used to reduce the standard rate of VAT.

Something along the lines of the EU's proposed carbon tax, in the form of increased excise taxes, should be gradually introduced, simultaneous with an enhanced programme for aiding efficient energy use on the part of those who cannot afford to undertake energy saving investment. According to the results of the ESRI's Medium Term Model, if the revenue from the carbon tax is used to reduce PRSI contributions, there is a net gain to the economy and to industry in particular. Total revenue from the carbon tax of £740 million is foreseen. It will be necessary to divert possibly 20 per cent of this compensate low-income households. A few energy-intensive firms may also come under stress. By definition these will be polluting and not labour-intensive firms, and their case for receiving transitional aid would need to be scrutinised.

In so far as climate change is a global problem and everybody's emission imposes similar damage, a universal carbon tax should be aimed for. There is an argument for addressing greenhouse gases rather than merely carbon dioxide, since these are the problem. Methane emissions, mainly from enteric fermentation in cattle, are the other principal source of greenhouse gases in Ireland. However these are only likely to be reduced, worldwide, by reduction in demand for the animal products, otherwise products will be sourced from elsewhere.

The $SO_2$ and $NO_x$ quotas allocated to Northern Ireland and the Republic should become tradable. If and when the quota limits are binding, quotas will have a value to the plants which can abate more cheaply than others. In addition to encouraging investigation of the costs of abatement for various options, this would achieve the specified targets at minimum cost.

Grant schemes need to be critically evaluated before they are adopted. In fact many grant programmes tend to be worthwhile in national terms, because many investments bring about net benefits. The stimulus which a grant gives also enables many new technologies to realise their potential, by achieving a critical volume of sales. With correct pollution taxes in place, the stimulus to technological improvements will also see price reductions come on stream. So, unless there are good external benefits or the conservation or new technology requires a small boost to get going, the case for financing grants, involving taxing the victims of pollution, requires scrutiny.

Knowledge is a prerequisite for markets and economic instruments to function. People may not be availing of opportunities because they are not sufficiently knowledgeable, or to do so entails using valuable management or leisure time to investigate the options, to choose the contractor who will supply the energy saving service, and to organise the investment. These are knowledge- and time-intensive activities. Yet much of the necessary information could be made available by central bodies, which can exploit economies of scale in information assembly and distribution. The Energy Audit Scheme can impart knowledge and helps the market to function. Activities which reduce other barriers to markets, or which actually provide external benefits ought to be encouraged, as ought renewables and other non-polluting technologies which come under the infant industry umbrella. In any event, the reality is that to make pollution taxes acceptable, some grants will be required, some of which may be strictly hard to justify. At least the grant level should be related to the ensuing societal benefits.

Procedures to enable the public sector to act "rationally" need to be in place. A three-year administrative budget in the public sector still limits efficiency investments to those with roughly a three year payback. The audit and efficiency grant schemes address the problem to some extent but may not engender a sufficient level of commitment once the grant has been paid.

Areas where policy-makers require more information before economic instruments should be applied include the following. The best manner to overcome the income distributional effects of higher energy taxes needs to be addressed, in order to promote the taxes' acceptability. Valuation of some of the damage[5] costs, of $SO_2$ and $NO_x$ for example, would be helpful in setting the level of emissions taxes or subsidies for abatement. In this way it will not be necessary to resort to foreign valuations.

[5] Work is underway on evaluation of the external costs of peat and coal fired electricity generation in Ireland, under DG XII's ExternE programme, ref. F. Convery and S. Rooney (forthcoming), *The National Implications in Ireland of ExternE*, Environmental Institute, Dublin.

**Appendix 6.1: Approximate costs of useful heat and $CO_2$ emissions from using different fuels**

| Fuel used | Cost per unit of useful heat<br><br>Pence/kWh of useful heat* | Carbon dioxide emitted per unit of useful heat<br><br>Kg $CO_2$/kWh of useful heat |
|---|---|---|
| **Open fire:**<br>Machine turf | 5.12 | 1.49 |
| Baled briquettes | 8.52 | 1.49 |
| House coal | 7.00 | 1.27 |
| Coalite | 11.48 | 1.27 |
| **Open fire + high output b.boiler:**<br>Machine turf | 3.01 | 0.88 |
| House coal | 4.12 | 0.75 |
| Coalite | 6.04 | 0.67 |
| **Oil fired boiler:**<br>Oil (gas oil) | 3.58 | 0.42 |
| **Room heater or gas fired boiler:**<br>Bottle gas (11.35 kg butane) | 9.91 | 0.33 |
| Natural gas (first 585 kWh/ 2 months) | 6.59 | 0.25 |
| Natural gas (Double up discount: min. 5850 kWh/yr) | 5.49 | 0.25 |
| Natural gas (Supersaver: min. 16000 kWh/yr) | 3.29 | 0.25 |
| **Electric fire:**<br>Electricity (General dom. rate) | 7.65 | 0.88 |
| Electricity (Night saver): night<br>" " : day | 3.05<br>7.65 | 0.88<br>0.88 |

*Notes:* * Useful heat is a unit of actual warmth enjoyed by the consumer, rather than a unit bought. The prices in this column give a better indication of the true relative prices of different fuels. Midpoint efficiencies were used in these calculations.
*Sources:* Prices from Forbairt, Scott (1995).

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