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Domestic energy efficiency in Ireland: correcting market failure

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Abstract

If the benefits of domestic energy efficiency are so great, why are they not reaped in actuality and what can be done about it? This paper deals with these crucial questions. It is based on the findings of a recent comprehensive study evaluating the costs (labour and materials) and benefits (energy cost savings, environmental benefits, including reductions in emissions of CO_2, NO_x, SO_2 and PM_{10}, comfort gains and mortality and morbidity impacts) to Irish society of bringing the entire housing stock up to the latest Building Regulations. The reasons for the lack of take-up of energy-conservation measures are discussed. The paper formulates policy proposals to address the impediments to effective action in the market for domestic energy efficiency. The various policy instruments available to overcome these barriers are outlined. Past performance, citing specific exemplars, both from abroad and from experience in Ireland, is reported. The final section suggests a mix of policy instruments to assist the realisation of the potential benefits of the energy-conservation programme. The principal initiatives recommended include the provision of a combination of grants to low-income households and a clear State-led information campaign explaining the benefits of conserving energy to the householder.

Keywords: Domestic energy efficiency; Market failure; Policy instruments

1. Introduction

Many studies have demonstrated the tangible net benefits of energy efficiency in the domestic sector. Studies at the micro level, including those of Pezzey (1984), Henderson and Shorrock (1989) and van Harmelen and Uyterlinder (1999), show the clear net benefits of individual retrofitting technologies. At the macro level, Arny *et al*. (1998), Blasnik (1998), Brechling and Smith (1994), Goldman *et al*. (1988), Skumatz (1996) and others demonstrate the benefits of comprehensive retrofitting programmes. However, two questions arise: why, if the net benefits of domestic energy efficiency are so great, are the take-up responses of such measures and programmes so disappointing? What can be done about it?

Having demonstrated the clear net benefits to Irish society of a programme to bring the entire housing stock up to the thermal standards of the latest Irish Building Regulations, the paper answers the following questions:

- Why does the market fail to ensure that society captures these benefits?
- What policy instruments are available to correct this market failure?
- What does past experience tell us?
- What mix of policy instruments would assist Irish society to capture the full benefits of the recommended domestic energy-efficiency programme?

2. Programme for domestic energy efficiency in Ireland

Ireland's housing stock has been identified as being among the least energy efficient in Northern Europe (Brophy *et al*., 1999). Recent evidence also suggests that the rate of fuel poverty[1] in Ireland (at 12%) is among the worst in Northern Europe (Whyley and Callender, 1997). Energy consumption in the domestic sector is greater than necessary, as people living in inefficient dwellings

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[1] The inability to heat the home to an adequate (safe and comfortable) temperature owing to low income and poor (energy-inefficient) housing standards.

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must consume more energy to heat their homes[2]. Consequently, environmental emissions are also greater. This is of considerable importance given that Ireland is having extreme difficulty in meeting its agreed target for stabilisation of greenhouse gas emissions under the European Union 'Luxembourg Agreement'. In addition, Ireland has a disproportionately high rate of excess winter mortality caused, in part, by failing to keep warm indoors (Brophy *et al*., 1999) and the inability to heat the home to an adequate temperature results in sub-optimal levels of comfort.

With these issues in mind, a study[3] was undertaken to evaluate a programme to retrofit the entire housing stock in Ireland with insulation and heating measures so as to bring it to the thermal standards of the latest Building Regulations[4]. The study contained the most comprehensive economic analysis of domestic energy-conservation opportunities in Ireland. Costs comprised of labour (€720 m) and materials (€881 m)[5]. The former was priced using an optimal mix of personnel from commercial and non-profit organisations, thereby overcoming capacity constraints in the heated Irish labour market. The retrofitting measures were chosen on the grounds of cost-effectiveness and include:

- Roof insulation
- Lagging jacket
- Draught stripping
- Cavity-wall insulation
- Central heating and controls upgrade
- Low-emissivity double glazing

The benefits of the programme include energy cost savings (€2712 m), health benefits (€1158 m), comfort benefits (€461 m) and environmental benefits (€396 m). The programme as a whole was shown to yield a net social benefit (NSB) of some €3124 m, with an internal rate of return of 33%, a benefit–cost ratio of 1.7 (energy savings alone) and 3.0 (aggregate programme benefits) and a payback period of just seven years. Fig. 1 summarises the key findings.

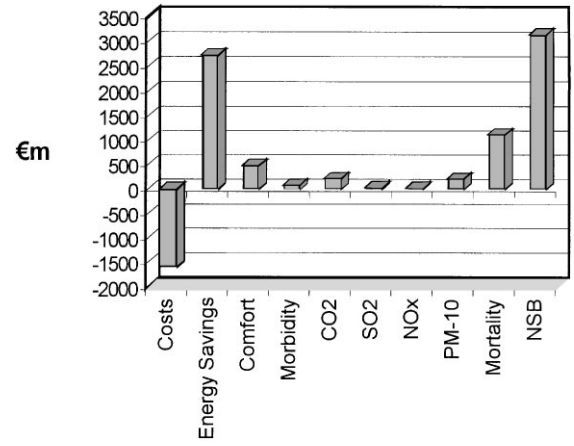

Fig. 1. Costs, benefits and net social benefit.

3. Why does the market fail to deliver energy efficiency?

The question arises as to why, if the benefits of the energy-conservation measures resolutely outweigh their costs, these measures are not adopted by individuals. The reasons can be explained by considering the following impediments to effective action.

3.1. Barriers to action

There are five barriers to action regarding domestic energy conservation:

1. The full nature, extent and magnitude of the benefits of domestic energy efficiency in Ireland were a matter for speculation until this study was undertaken.
2. The programme is expensive, costing in total (public and private) about €292 m (undiscounted) annually over 10 years. Heretofore, public finances were such that fiscal rectitude, combined with the need to meet the Maastricht Criteria, limited the extent and willingness on the part of the State to embark on substantive investment programmes in energy efficiency.
3. For private households, the recessions of the 1980s resulted in declining disposable income and a subsequent unwillingness to finance new retrofit investment; it is only in the past five to seven years that growth in real household income has been significant (Convery, 1999) and so this constraint has been relaxed considerably.
4. Policy responsibility is spread across about 10 departments and agencies. Under the prevailing institutional arrangements, there is no one institutionally or politically positioned to 'champion' such a programme.
5. Irish energy policy has traditionally focused on supply-side interventions and neglected demand-side options, despite numerous government policy statements to the contrary (Lawlor, 1995; McSharry, 1993).

3.2. Private vs. social benefits

A social cost–benefit analysis considers all the benefits to society of a programme to retrofit the entire housing

[2] It has also been shown that the poorest individuals tend to spend three times more than the average on energy relative to income (Clinch and Healy, 1999).

[3] Brophy *et al*. (1999).

[4] Department of the Environment and Local Government (1997).

[5] All costs and benefits are discounted at 5%. At time of writing €1 = $1.07 = £0.66 = IR£0.79.

Table 1
Costs, energy savings and net benefit from the households' perspective

Private discount rate (%)	Investment costs (incl. Tax)	Reductions in energy bills (incl. Tax)	Net private benefit (NPB)
0	− €2,898.46	€7,452.47	€4,554.02
3	− €2,478.74	€4,313.68	€1,834.94
5	− €2,247.51	€3,099.05	€851.55
8	− €1,957.69	€1,977.36	€19.67
10	− €1,795.42	€1,507.83	− €287.60

stock so that it meets the thermal standards of the 1997 Building Regulations. However, an individual normally only takes account of the direct benefits to him/herself, i.e. the private benefits of energy-efficiency measures. External benefits which are captured by wider society (e.g. reductions in emissions and in morbidity costs to the State) tend not to be considered when a private individual is considering whether to invest in such measures. The payback periods and net benefits of various measures and programmes are adversely affected by the exclusion of non-private benefits.

Moreover, some of the private benefits, such as reductions in the risk of illness being non-monetary in nature, are often not considered by the householder when making financial decisions. It is most likely that the householder will consider the cost of the energy-efficiency measures and compare it to the reductions in energy bills they can expect to receive as shown in Table 1. It is important to note that in this 'Financial Analysis', unlike in the cost–benefit analysis, taxes are included because they must be paid by the individual household.

However, inspection of the table shows that the net private benefit is still positive at our test discount rate of 5%, so there must be other reasons for the lack of uptake of such measures.

3.3. Market interest rate vs. social discount rate

There is no agreement on an appropriate figure for the social rate of discount. In the cost-benefit analysis summarised above, a range of discount rates was used and the Irish Government's test discount rate of 5% was used for the purposes of policy analysis. While this might be considered the appropriate rate for the social cost-benefit analysis, it is less applicable to the private individual. Those who are considering improving the energy-efficiency of their house may not have funds readily available and therefore will be considering taking out a loan from a financial institution. Currently, the rate of interest to be paid on loans is often in excess of 9% in Ireland. At such rates, the net private benefit to an individual becomes negative, i.e. a financial analysis undertaken by the householder would suggest that investment in retrofitting measures would be financially unwise. For the Programme being considered, energy cost savings alone outweigh investment costs at a 9% discount rate.

Taxation plays a role in the above finding. Retrofitting costs are more expensive to the individual householder than to the state as the individual must pay tax on the costs whereas these are omitted in a social cost–benefit analysis. While energy savings will seem greater to the individual as they will save on paying this tax (a saving of €176 m), labour taxes and value-added tax outweigh this benefit such that the investment costs of this Programme are €517 m higher when taxes are included.

3.4. Socio-economic considerations

The least energy-efficient households are more likely to be lower income households (Clinch and Healy, 1999; Whyley and Callender, 1997; Brechling and Smith, 1994). This is likely to compound the results shown above. Such households are much less likely to have available funds and, thus, are most likely to have to resort to a loan. They are less likely to be in the position of accessing credit (particularly at the market rate of interest)[6] and they are more likely to have more pressing alternative uses for any extra funds. They may, additionally, have an aversion to borrowing funds, as has been reported by Salvage (1992). It has also been shown that low-income households tend to have higher discount rates, i.e. they exhibit myopic tendencies whereby they place a greater value on income now as opposed to in the future, partly resulting from the higher degree of uncertainty about the future stemming from their financial instability. Therefore, all else being equal, such households are unlikely to invest in something that might not pay for itself for over 30 years.

In relation to the policy process, many of those who would benefit most are poor and relatively old and not well represented in the lobbying arena (Clinch and Healy, 1999).

3.5. Information gap

One of the principal reasons for financially viable energy-conservation measures not being taken up is the lack of knowledge on the part of householders of the opportunities for saving on fuel bills[7]. This information gap is likely to be greater in low-income households where the benefits would be greatest. In addition, an information asymmetry between buyers and sellers of energy-efficiency measures may occur, leading to adverse selection of such technology[8].

[6] See Weber (1990) for more on this issue.

[7] Lack of information is seen as a key reason for market failure in the UK according to Williams and Ross (1980) and Carlsmith *et al.* (1990).

[8] See Smith (1992).

In addition, if the housing market worked effectively, the monetary value of the energy-efficiency measures would be reflected in the re-sale value of the house. However, if the public is lacking in knowledge as regards the benefits of the measures, this will not happen. Therefore, if individuals are likely to move house in the meantime, they may not be willing to make an investment with a long payback period.

3.6. *Transactions' costs*

Another potential 'blockage' in the market for energy-efficiency measures is that of the fixed costs of learning about, and administering, energy-conservation measures. Examples of transactions' costs include the time householders must spend to learn about the various options, locate a suitable installer and oversee the work. Some householders may also be concerned about the appropriate techniques and the quality of the workmanship, as well as the attendant disruption of installing these measures. Such costs are not reflected in the cost–benefit analysis and, therefore, the full costs of retrofitting households with energy-conservation measures may be significantly higher to the individual than is suggested by our figures. The amplitude of these transactions' costs may overwhelm the potential pay-off of such an effort, acting as a performance-inhibiting 'wedge' which prevents the implementation of cost-effective energy-conservation measures in the home. These transactions' costs are difficult to measure, but are potentially the key factors in explaining the slow take-up of financially viable measures, especially in the domestic sector (Convery, 1998).

The absolute benefits per household are relatively small. When you add the value of all the energy savings together, they amount to an average of almost €762 per annum over the 10-year period. However, spread over the number of households, the financial gain is small per household at about €635 per annum. In addition, low and (until recently) declining real energy prices, making the energy budget a falling share of total household expenditure, may also act as a barrier; this hypothesis is explored formally in Hassett and Metcalf (1992). In short, we believe that the hassle involved in finding out about the retrofit programme, arranging with a contractor, and ensuring access and supervision (the "transactions' costs") may be the primary candidate for discouraging private investment.

3.7. *Property rights failure*

Some of the least energy-efficient houses in the UK are tenant-occupied (Boardman, 1991; Brechling and Smith, 1992). The same would appear to be the case for Ireland (Brophy *et al*., 1999). Tenants may feel that they are not responsible for undertaking investments in energy efficiency or authorised to do so. Indeed, it is not financially sound for a tenant to invest if they expect to move out in the short to medium term. Likewise, landlords may feel that the benefits to them of such investment may not be recouped if they are unable to raise rents. Also, if investment does take place in a multi-occupancy dwelling, 'free-rider' incentives may exist in relation to the financing of the public good (Smith, 1992).

3.8. *Conclusion*

There are a number of reasons why energy-conservation measures may not be taken up by the private household: such a household is unlikely to take into account all the benefits to themselves and to wider society of such measures; they may have to borrow funds at an interest rate that would make the investment prohibitive; they may not be aware of such energy-saving measures; the transactions' costs of installing such measures may render the investment unwise. Moreover, the households which would benefit most from the installation of more energy-efficient technologies are: least likely to make such a long-term investment; more likely to have to borrow funds (often at a rate of interest higher than the market rate); more likely to have more pressing priorities for extra funds; likely to find it more difficult to obtain such funds; less likely to be aware of energy efficiency opportunities; less likely to live in their own house.

Policies to close the gap between the positive social benefit of the installation of energy-efficiency measures and the negative private benefit of such measures must therefore endeavour to:

1. Close the information gap.
2. Reduce the opportunity cost of investing funds in energy-conservation measures.
3. Make such funds more widely available.
4. Reduce the transactions' cost of such investments.
5. Make private benefits reflect more closely the social benefits of such measures.
6. Reduce property-rights failure.

4. Instruments available to policy-makers

There are a number of instruments available to policy-makers to correct for market failure. These are discussed in the following subsections.

4.1. *Regulation*

Regulation, also known as command-and-control, endeavours to improve the performance of the market via the setting of standards, e.g. building regulations. Non-compliance with a standard results in a penalty, usually

in the form of legal action and/or fines. Regulation is likely to be most effective for new housing where minimum standards can be set for insulation. However, it could be mandatory that energy-conservation measures be installed each time a house is sold. It might also be required that information on the energy efficiency of a house (energy rating) be issued whenever a house is sold (see 'Information' below). Landlords could be required to provide minimum heating standards and/or specify the thermal characteristics of the residence to potential renters. However, where the supply of rental accommodation is relatively fixed, the cost may be passed on to those renting the accommodation.

4.2. Taxes and charges

Environmental taxes and charges are economic instruments. These instruments are put in place by a policy-maker to alter market signals to encourage or discourage certain activities or behaviour. A tax on energy generated from fossil fuels may be part of a strategy to reduce emissions of greenhouse gasses. This would provide an incentive to invest in energy-conservation measures. However, energy tends to be price-inelastic and so, when the substitutes for energy generated from fossil fuels are limited, such a tax may not be effective unless combined with other policy instruments.

4.3. Tradeable permits and offsets

Emissions trading is also an economic instrument. Rather than being a price instrument (like a tax), it is a quantity-based instrument. In the Kyoto Global Warming Protocol, compliance with the greenhouse emission quotas can be achieved, in part, by purchasing from others who have a quota to spare. A price emerges for the permits which reflects the scarcity value of the environment. If such a trading system is put in place, it may be possible for households who emit a low level of greenhouse gas emissions to sell the carbon reduction to a company that requires emission credits. Such a system will increase the incentive to invest in energy efficiency. However, the practical implementation of such a trading system might prove difficult.

4.4. Information

The failure of the market to provide information on the benefits to the householder of energy efficiency can be corrected by improved information provision by the government (see 'Institutional Development' below). As such, information provision can be considered an economic instrument. Provision of information on the benefits of improvement, in the form of an easily read leaflet and a list of installation companies, etc., would substantially reduce the information deficit. As mentioned above, the inclusion of an energy rating in the specifications of a house on the market could be quite effective as could the provision by landlords of information regarding the thermal characteristics of the residence available to rent.

4.5. Subsidies and tax relief

Removal of subsides, if any, on energy products would enhance the incentives for energy efficiency. Tax relief (e.g. on the costs of retrofitting) and grants for energy-conservation measures in homes by the government are other potential instruments.

4.6. Voluntary approaches

A voluntary agreement by estate agents that information on the thermal specifications of houses be included in sales literature could have potential. While voluntary agreements by firms to reduce environmental emissions has been shown to work, in the absence of other incentives, it would be difficult to get individual households to agree voluntarily to install energy-conservation measures.

4.7. Institutional development

While not a policy instrument as such, institutional issues are very important. Energy efficiency is usually the concern of a number of government departments. In order to mobilise the policy process, it is helpful if a focal point is established to co-ordinate policy approaches and to lead the information campaign.

4.8. Research and development

The stimulation of research into the best opportunities for energy efficiency is beneficial. The construction of cost–benefit analyses and the recommendation of appropriate policy responses are sometimes hampered by a lack of data.

5. Ex-post exemplars

There are a number of lessons for policy-makers that can be drawn from past experience, both abroad and in Ireland. Convery (1998) lists three examples:

(a) *Subsidy and direct investment.* This instrument can yield substantial net benefits if certain conditions are met. Firstly, it is important to focus on the most cost-effective measures, as has been done in this programme. Experience from Germany corroborates this. The performance of their 1978–1983 grant/tax-rebate scheme was poor because the subsidy for householders assisted window replacement and double-glazing — 77% of the scheme's

funds went towards these measures. The energy savings from these measures are often modest. Conversely, experience in the UK and Ireland has shown that measures such as attic insulation and draught-proofing tend to harvest much more substantial gains in energy reduction.

Secondly, the greater the number of households that avail of State-aided energy-conservation programmes, the lower the marginal cost per household will be. In the UK, some 600,000 households availed of the Home Energy Efficiency Scheme; thus, the overhead cost per household was minimal.

Finally, the net gain from energy-conservation programmes, in terms of energy savings, can be modest. However, it is important for policy-makers to include the significant comfort and health benefits, as well as the external benefits such as environmental emissions reductions, in assessing a programme. In this programme, these non-monetary private benefits account for 35% of total programme benefits.

(b) *Information*. Written advice, based on a response to a completed questionnaire, is the most cost-effective means of transmitting information about energy-conservation opportunities to households. According to experience in Germany, the take-up of advice is similar across most possible forms of campaigns. However, the written form is shown to be the most cost-effective. It is important, however, to be aware of any potential professional bias, i.e. expensive options being advocated on a basis other than cost-effectiveness may lead to adverse selection.

(c) *Demand-side management (DSM)*. DSM can lead to considerable net benefits, as has been seen from the Welsh example of encouraging compact fluorescent lighting (CFL). However, several criteria must be met first. Crucial in this regard is the achievement of economies of scale; there are considerable start-up and administrative costs involved with DSM. It is crucial that the right incentives are provided to utilities. In practise, policy regarding pricing must be designed (e.g. uncoupling revenue from units sold) such that net revenues do not suffer as a consequence of embracing DSM. In the case of compact fluorescent lighting (CFL), a combination of subsidy (pay on bills) and information is required to achieve significant take up. Finally, considerable skill and technique are required to market the DSM programme.

6. Proposed policy mix

So far, this paper has shown that:

- there are considerable benefits to society from bringing the housing stock up to the standards of the 1997 building regulations;
- there are clear reasons why the market fails to deliver this benefit;
- there are a number of policy instruments available to correct this market failure.

The question remains as to how Ireland's policy-makers can best use the available instruments to ensure that the benefits of energy efficiency in the domestic sector can be appropriated. The Irish economy is the fastest growing economy in the European Union. With record exchequer returns and budget surpluses, the Irish Government is now in a position to embark on new investment programmes, provided that the returns justify the costs. In addition, many private households likewise have sufficient disposable income and capacity to borrow funds to undertake new investments. However, a household energy efficiency strategy, which is comprised of a mix of instruments, is required to mobilise the market to achieve the potential for domestic energy efficiency.

The household energy strategy could firstly distinguish between those households who have sufficient income to finance retrofitting conservation measures and those who don't. The former households will have relatively low discount rates and have savings that can be diverted to undertaking such an investment.

An information campaign is required to bring the opportunities to the attention of those households who, once they are aware of the opportunities, will find it worth while to invest in energy efficiency. It would be best if such a campaign were co-ordinated by one body which can provide easily understood and reliable information. It would help if research and development into the most appropriate technologies and the most effective points of intervention were encouraged.

In addition to the information campaign, it is equally important to minimise transactions' costs. Those households with relatively high incomes may also have a high opportunity cost of time, i.e. they may be unwilling to exchange a relatively small saving in energy expenditure for the time involved in sourcing a company to carry out the work and arranging for them to spend time in their house. A scheme which targets particular areas of housing for retrofitting and lines up appropriate construction firms can minimise these costs. Such large-scale schemes can capture significant economies of scale which are assumed in the cost–benefit analysis.

Energy ratings should be specified in the sales literature provided for both new and second-hand houses. Such a rating costs approximately €190 (Combat Poverty, 1999). This could be achieved by voluntary agreement with estate agents or be required by law.

Ireland has already exceeded its mandatory target for greenhouse gas emissions under the EU Luxembourg Agreement of 13% over 1990 levels. It is clear that the government will have to resort to economic instruments such as a carbon tax or an emissions trading system if it is

to meet the target in 2012. Any policy which increases the price of energy while providing cost-effective methods for reducing energy use will assist in encouraging households to take advantage of energy-conservation opportunities.

Many of the least energy-efficient houses are occupied by low-income families. Full cost grants are likely to be necessary if these houses are to be encouraged to capture the benefits of energy efficiency[9]. Much of the benefit will accrue to these households in the form of increased comfort and lower morbidity and mortality as a result of warmer homes.

Many energy-conservation programmes fail to deliver because of a lack of political and institutional leadership. In Ireland, for progress to be made, it is recommended that there be leadership at the national level, preferably by the Department of the Taoiseach (Prime Minister). One approach would be to set up a Cabinet-level sub-committee to ensure that interdepartmental stasis does not inhibit progress.

7. Conclusion

Like many studies in other countries, an Irish study has demonstrated that investing in energy efficiency in the domestic sector makes good economic sense. The study upon which this paper is based provides clear evidence that a cost-effective package of energy-saving measures has a high net social benefit, a short payback period, a high internal rate of return and a resolute benefit–cost ratio. Yet, it remains to be seen whether or not the net benefits of such a programme will materialise in actuality. Evidence suggests that, in reality, a number of impediments act as performance inhibitors to these programmes. To overcome these difficulties, a policy mix must be formulated. For the successful implementation of this programme, the government will need to intervene to correct for a number of failings in the market. The principal initiatives recommended include the provision of a combination of grants to low-income households and a clear State-led information campaign explaining the benefits of conserving energy to the householder and minimising transactions' costs. Failure to act will mean that the economy, the environment and the health status of the Irish will be the poorer, and the costs of inaction will be felt by those who can afford it least.

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[9] A revolving loan scheme that facilitates low-cost loans might also be a possibility.

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