Employment generation from energy efficiency programmes: enhancing political and social acceptability

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1. SYNOPSIS

An important message for policy makers: an EU study which demonstrates clearly that employment creation is a side-effect of most energy efficiency investment programmes.

2. ABSTRACT

Energy efficiency investment programmes can create employment. Action co-ordinated at the European level has the most positive impact, but actions at the national and local level can also have beneficial employment effects. Although providing solutions to the problems of unemployment will never be a key aim of energy efficiency policy, the positive employment side-effects of policies and programmes may prove useful in building support for energy efficiency investments across government departmental boundaries. This is particularly the case where programmes can demonstrate positive impacts for social groups currently disadvantaged in the employment market (for example those with low skills and few qualifications, living in economically deprived areas).

This paper presents the results of a SAVE-funded study of the employment impacts of energy efficiency investment programmes in nine EU Member States. Based on detailed case studies of 44 individual programmes and modelling of the wider effects, the study investigated short- and long-term impacts, both on total numbers of employed persons and on the skills mix utilised in the economy.

The study results are summarised and key points highlighted. Limitations of the study are identified and suggestions are made as to the key areas where further research effort would be beneficial.

Implications of the study findings for decision-makers at the local, national and EU level are suggested, set within the framework of promoting environmentally and socially sustainable economic development. Issues such as the differing impacts of various policy types and the potential for replicability of impacts across national boundaries are discussed.

3. INTRODUCTION

This paper summarises the results of a SAVE funded study of the employment impacts of energy efficiency programmes in 9 EU Member States (Austria, Finland, France, Germany, Greece, Ireland, the Netherlands, Spain and the United Kingdom) (Wade *et al*, 2000). The study was based around case studies of 44 different energy efficiency programmes and also included I/O consumption function modelling of consumer oriented programmes and general equilibrium modelling of the medium term effects on employment in the wider economy. Using the results of the study, the paper puts forward some suggestions of their usefulness for energy efficiency policy makers and implementers.

The study was undertaken to address the lack of current information about the employment impacts of energy efficiency programmes: despite widely held convictions about the positive (or negative) effects on employment of energy efficiency investments, there existed very little up to date information based on real programmes, and

no attempts to use such information in the modelling of direct and indirect employment effects in the wider economy.

Concern about unemployment levels in EU countries remains high, despite falls in the unemployment rate following the high levels of the early 1990s. Also there are certain social groups where unemployment is a particular cause for concern: the unemployment rate tends to be higher for those with lower skills and educational achievement levels and those who have been out of work for extended periods of time. There are also particular geographical areas with unacceptably low levels of employment. The study considered whether energy efficiency programmes have anything to offer these groups in particular.

The next section of the paper reviews briefly the methodology of the study. Following this, the key results are summarised and discussed. Then a review of the limitations of the study leads to suggestions for further work.

The paper concludes with consideration of the implications of the study results for the energy efficiency policy maker.

4. METHODOLOGY

The study included three complementary approaches to assessing employment impacts: case studies of individual energy efficiency programmes and their direct employment impacts, lifestyle-oriented input-output modelling of the wider (direct, indirect and induced) employment impacts of residential sector programmes in the short to medium term, and general equilibrium modelling of employment impacts at the macro level.

The case studies

The case studies formed the core of the project. They provided detailed information for selected policy programmes and instruments and impact assessment of incremental energy and direct employment effects in qualitative and quantitative terms. As the study aimed to cover as wide a range of energy efficiency policy activities as possible, potential case studies were characterised against the following criteria prior to selection: policy type; end-use sector; end-use; initiator (the main driver behind the implementation of the programme), and founder.

The choice of case studies considered this characterisation together with the likely availability and quality of data about the programme. Cases were chosen without prejudice regarding the likely employment effects or cost-effectiveness of the measures included, but merely as a sample of typical programmes across the EU. Table 1 summarises the programmes selected as case studies.

Table 1. Case studies selected

Case studies – by country	Residential			Commercial & public		Industrial		Institutional change	
	Fiscal	Regulations	Information	Fiscal	Information	Fiscal	Information	Utility DSM	Other institutional
Austria									
AU1: Soft loan programme for energy efficient new homes	_								
AU2: Energy advice services for private households			_						
AU3: Sectoral energy efficiency plan: plastics industry							_		
AU4: Impulse programme exchange of heating systems	_			_					
AU5: Programme for retrofitting of single-family houses	_								
AU6: Programme for new energy-efficient multi-family housing	_								
AU7: Sectoral energy efficiency plan: bakeries							_		
Finland									
FI1: Energy consumption feedback and focused advice for households			_						
FI2: The voluntary agreement of the City of Helsinki									_
FI3: Energy audit programme of Finland					_		_		
France									
FR1: Income tax incentives for energy savings in existing housing	_								
FR2: Promotion of efficient electric appliances			_						
FR3: Environmental buildings for the education sector					_				
FR4: Demand side management in the industrial sector								_	
FR5: Regional programme for energy conservation / energy management in the Nord-Pas de Calais region									_
FR6: Demand side management for electricity in rural areas								_	
Germany									
GE1: Thermal insulation ordinance		_							
GE2: Heating system ordinance		_							
GE3: CO_2 reduction programme of Kreditanstalt für Wiederaufbau	_								
GE4: ERP energy saving programme of Deutsche Ausgleischsbank				_		_			
Greece									
GR1: Operational programme for energy									
GR2: Introduction of energy saving techniques in the building regulation – Improvement of energy efficiency in the housing sector.			_			_			

Case studies – by country	Residential			Commercial & public		Industrial		Institutional change	
	Fiscal	Regulations	Information	Fiscal	Information	Fiscal	Information	Utility DSM	Other institutional
Ireland									
IR1: Attic insulation grant scheme	_								
IR2: Hospital CHP scheme				_					
IR3: Energy action scheme	_								
IR4: Energy audit grant scheme					_		_		
IR5: Steam boiler programme									_
IR6: Low energy housing (a demonstration project)			_						
The Netherlands									
NL1: Tender industrial energy saving						_			
NL2: Energy performance standard		_							
NL3: Highly efficient heating boilers								_	
Spain									
SP1: ECEP programme for the industry sector in 96 & 97						_			
SP2: ECEP programme for the service sector in 96 & 97				_					
SP3: Third party financing in the industry sector in 96 & 97									_
SP4: Third party financing in the service sector in 96 & 97									_
SP5: Demand side management programmes for the domestic sector in 95 &97								_	
SP6: Demand side management programmes for the industry sector in 97								_	
United Kingdom									
UK1: Home Energy Efficiency Scheme	_								
UK2: MANWEB demand-side management scheme								_	
UK3: Standards of Performance for energy efficiency								_	
UK4: Heatwise	_								
UK5: 1995 building regulations		_							
UK6: Fridgesavers								_	
UK7: Scottish Hydro-Electric's 'Shetland integrated resource planning' scheme								_	

All partners worked to a standard data collection format (Scott, 1998) to ensure that, wherever possible, consistent information was collected across all cases. In addition to considering the direct employment effect and additional data required for the modelling exercises, the case studies provided an opportunity to collect information about the qualitative effects of policies such as the types of employment generated and the time profile of additional employment.

Lifestyle oriented I/O modelling

Input-output modelling allows the tracing of economic impacts of investment decisions to all the economic sectors affected. I/O models are static, in that coefficients relating economic sectors are fixed in national statistical tables, and no dynamic relationship between demand, prices and quantities is made.

In this study conventional I/O modelling was enhanced by also considering consumer behaviour, based on the Dutch ELSA model, E^3Life models for Germany and France, and similar models developed by the project for Spain and the United Kingdom (Jeeninga *et al*, 2000). Households are distinguished by age, income, education level, number of adults and number of children. Their consumption functions are then modelled for broad expenditure categories such as food, clothes, home, leisure, transport and health. These expenditure categories are subdivided, normally into 16 sub-groups, with the level of detail varying between countries. It is also assumed that a proportion of household income goes into savings. The combination of national I/O tables and national consumption functions allows estimation of indirect and induced employment impacts of changes in consumer expenditure that result from energy efficiency programmes. Given the emphasis on consumption rather than production in these models only energy savings in the residential (consumer) sector were considered.

The impacts on employment resulting from energy efficiency programmes in the consumer sector can be divided into 4 categories: direct purchase effects; indirect purchase effects; energy saving effects, and government budget effects. In order to calculate these effects a reference scenario was created. This was identical to the policy intervention scenario in respect of all assumptions concerning key variables such as future energy prices, GDP growth and changes in labour productivity.

The intervention scenarios were then investigated using data from the case studies on initial costs, maintenance costs, government outlay and energy cost savings. The payment method for energy savings investments affects the employment impacts, since different sectors will experience cash injections or withdrawals as a result, and labour intensity varies across sectors. Energy savings investment can be financed in 4 ways (or a combination of them). These are: general consumption budget; loan financing; subsidies, and savings. These methods were differentiated in the modelling.

A base year of 1995 was chosen, with costs and savings over the lifetime of investments discounted to this base year. Employment impacts were then evaluated for years 2000 and 2010.

All programmes treated in the I/O modelling affect consumer investment in energy efficiency, even where they are not classified as 'residential' for the purposes of this study. The case studies considered were as follows:

- 4 fiscal initiatives in the residential sector: (FR1, GE3, UK1, UK4).
- 4 regulatory initiatives in the residential sector: (GE1, GE2, NL2, UK5).
- 4 initiatives in the Utility DSM sector: (NL3, SP5, UK3 and UK6).
- 1 programme in the commercial/public sector is included: (FR3).
- 1 initiative in non-utility institutional change (FR5).

Macro-economic modelling with GEM-E3

General equilibrium modelling was used to compare theoretical situations where the EU economy is enjoying general equilibrium growth, with and without diversion of funds into energy saving schemes using the GEM-E3 model (Capros *et al*, 2000). The GEM-E3 model allows dynamic economic (and employment) effects to be investigated on an EU-wide basis, unlike I/O modelling which looks at impacts within one country and affords a less dynamic, but more 'real world' perspective.

The national case studies of energy efficiency schemes were used as a starting point, but the level of investment was scaled up considerably (aiming at somewhere in the region of 1-2% of GDP) so that the direction of macro-economic impacts became evident. Therefore the sectoral coverage and sources of funding reflected real national priorities, but the size of the investments was scaled-up to between 0.7 and 2.1% of GDP. To simplify comparisons, the schemes were all assumed to involve a 5-year investment period followed by 20 years of energy savings.

The model includes all EU member states, and considers 18 production sectors and 13 household consumption categories. (In its current form the model assumes all households in the EU are alike). Government expenditure

is differentiated by financing method and policy types, such as carbon taxes. Trade relations between EU member states, and between the EU and the rest of the world, are also modelled dynamically (e.g. terms of trade automatically adjust to correct changes in national current accounts). The model also estimates effects on pollutant emissions and money values of damages in terms of environmental externalities.

It is assumed that energy efficiency schemes result in an increase in expenditure on durable goods (e.g. appliances, insulation materials) but lower expenditure on energy. These changes affect expenditure of the household or business budget across all consumption categories. Government funding causes an increase in public sector borrowing, and taxes have to be raised to repay the deficit. This contrasts with the I/O modelling which assumes that funding is from a re-allocation of existing funds, reducing spending within the government sector and boosting spending in the residential sector. Here raised taxes counteract the transfer to consumers. It is assumed that the government raises a carbon tax at the exact level necessary to repay the public borrowing over a period of 15 years.

Three scenarios were investigated using the GEM-E3 model:
- Single country application. It is assumed that each member state applies its policies as described in the case studies (scaled up to approximately 1-2% of GDP) while other countries do nothing.
- Nine-country application. Here all 9 countries apply their different national programmes of investments simultaneously.
- Extension to the whole EU. A generalised energy efficiency programme (derived by averaging data from the case studies) is applied on an EU-wide basis.

Differences in the strengths of national economic sectors and in trade relations make the direction of impacts differ between countries and for the EU as a whole. It must be stressed that it is the direction of changes that are important rather than magnitudes.

5. KEY RESULTS

Although job creation was not the primary stated aim for all but one of the programmes studies here, and indeed programmes were explicitly not selected on the basis of their potential to generate employment, the case studies and modelling exercises found that employment gains have been an indirect consequence in virtually every case.

Direct employment: results of the case studies

Direct employment gains identified by the case studies were in the region of 8 to 14 person-years per million _ of total investment: a relatively small level of direct employment generation for the size of investment. Case studies in the residential sector typically demonstrated higher direct employment gains than those in other sectors, although the cost effectiveness of the programmes, in terms of energy savings, tended to be lower than in other sectors, and hence the overall employment gains may not be as high.

Direct employment frequently involved jobs in sectors, locations and skill groups that are prioritised in employment policies. For example new employment in manual occupations often accounted for the majority of the direct employment generation, particularly for programmes in the residential sector. Employment in a range of more skilled occupations (engineers, technicians, consultants) was generated in some cases, particularly in industrial sector programmes.

The time profile of direct employment identified in the case studies generally fitted one of three patterns: a consistent level throughout the programme, or a steady growth in early years followed by either a levelling off or a slow decline for the remainder of the programme. These patterns reflect the specifics of programme design and implementation rather than being typical of different policy types.

Looking at individual case study results in more detail, different policy types were compared against a number of key criteria:
- Payback periods for investments;
- Employment gain per unit of expenditure; and
- Employment gain per unit of government expenditure.

Note that these relate to the employment impacts of the policies: they are not necessarily indicators of good energy efficiency policies.

Table 2 summarises key data from the case studies. The rankings are based on median figures which, whilst not ideal with low samples, were preferred to mean averages to avoid distortion caused by very low or high figures that can be unrepresentative. Employment figures are those identified in the case studies prior to modelling, and include only direct employment in manufacturing, installation and maintenance of energy efficiency measures, and in the administration of schemes.

Table 2. Ranking of summary data on case study policies

TYPE OF INITIATIVE *Sector* (number of case studies)	Programme size[1]			Performance against criteria[2]		
	Total expenditure.	Duration studied	Expenditure per year	Simple payback period	Person-years identified per million _	Person-yrs identified per Million _ government spending
FISCAL						
Residential (10)	5	9	3	7	2	8
Commercial/public (4)	3	2	4	6	6	7
Industry (5)	2	9	2	5	9	9
REGULATORY						
Residential (4)	1	1	1	8	5	1
INFO./EDUCATION						
Residential (5)	9	7	8	9	1	2
Commercial/public (3)	4	3	6	2	8	6
Industry (4)	8	7	9	2	4	4
OTHER						
Utility DSM (9)	6	5	5	4	7	3
Institutional change (5)	7	5	7	3	3	5

Notes

[1] 1 = largest / longest, 9 = smallest / shortest

[2] 1 = 'best' i.e. shortest payback or largest employment gain', 9 = 'worst' i.e. longest payback or smallest employment gain

Whilst the rankings are interesting because they provide an initial characterisation of different policy types, there is more work to be done before the results can provide much guidance to the policy maker on the relative merits of classes of policy programme. For example, information and education campaigns and innovative institutional programmes (such as promotion of energy service companies or regional energy efficiency campaigns) appear to combine high employment gains, low government expenditure and cost effective investments. Note however, that data on the impacts of education and information campaigns are usually more uncertain than for other policy types, and hence any such conclusions should be treated with caution.

Input-output modelling for the residential sector

The input-output modelling results confirm that there are net employment gains in virtually all cases. Table 3 illustrates these results in terms of net employment impacts. Note that these are total impacts over an extended time period (up to a maximum of 30 years in some cases).

They suggest that employment gains for fiscal and regulatory policies are of a similar magnitude to the findings of the case study approach (median employment gains in the region of 11-13 person years per million _ invested). However, they do suggest that the case study approach underestimates the positive effects of institutional programmes such as DSM initiatives: the modelling results suggest a median employment gain of 29 person years per million _, whereas the case studies identified effects in the range of 8-14 person years per

million _. This difference demonstrates the fact that a case study approach cannot reflect fully the positive economic stimulus caused by private (rather than government) investment.

Table 3. Summary results of I/O modelling

Scheme (Country, ref.)	Net employment (person years)	Net employment per Million _ invested	Net employment per Million _ Government investment
Fiscal, residential schemes			
France, FR1	71400	12.9	106.9
Germany, GE3	-4200	-9.5	-31.7
United Kingdom, UK1	3815	9.3	9.3
United Kingdom, UK4	42	14.2	14.2
Regulatory residential schemes			
Netherlands, NL2	1000	12.6	-
Germany, GE1	3800	Negligible	-
Germany, GE2	17400	4.5	-
United Kingdom, UK5	7100	93.1	-
Miscellaneous others			
France, FR3	81.7	11.5	11.5
Netherlands, NL3	3800	12	372.5
Spain, SP5	3344	50.7	265.4
United Kingdom, UK3	12260	98.1	-
France, FR5	191	28.9	34

As the more detailed I/O modelling results demonstrate (Jeeninga *et al*, 2000), higher cost-effectiveness of investments and/or lower government expenditure lead to greater overall increases in employment. Both these effects can be explained simply. Increasing cost-effectiveness of investment creates a greater transfer of spending, per _ invested, from energy supply to other aspects of household expenditure, and energy supply is relatively labour extensive compared to other sectors of the economy. The benefit of private, rather than government, expenditure reflects the assumption within the modelling that if government money were not spent on energy efficiency investments it would be spent within the government sector (i.e. it would not be diverted to other private sector spending). This is a conservative assumption, minimising the employment effects of government investment in private sector energy efficiency, as the government sector itself is very labour intensive. (Note that the single case which results in negative employment effects involves a programme of investments for householders which are not cost-effective in terms of fuel bill savings, and where the investments are financed by government-subsidised loans.)

GEM modelling

General equilibrium modelling also demonstrated that the wider effect of energy efficiency investment programmes on employment is positive. Although the scaling up of programmes for the purposes of this modelling exercise means that the absolute magnitude of effects is not certain, the consistently positive results are encouraging.

Whilst a simulated unilateral application of energy efficiency programmes by single EU Member States always produced a positive outcome at the national level (and at an EU level in the long term), in this scenario there could be short term job losses at the European level in the short term.

Modelling the simultaneous implementation of different programmes in all EU countries suggests that the overall employment impact in the short term (whether positive or negative) would be reduced compared to the previous option. However, co-ordination of a single EU energy efficiency policy would eliminate any short-term job losses and lead to larger and more persistent employment gains than in the other scenarios.

6. AREAS FOR FURTHER WORK

Whilst every care was taken in the study to provide a rigorous and systematic empirical analysis of a broad range and large number of energy efficiency initiatives, data availability and quality varied from case to case and country to country. Hence, whilst the broad comparative results presented here can be justified, more detailed analysis or comparison between individual case studies would produce results of little value.

There may be opportunities for closer analysis of a sub-set of the case studies used here, to elucidate further answers to a number of key questions. These include: why seemingly very similar policies had very different impacts in different countries; how the detail of policy design can affect employment impacts, and how individual programmes impact on specific areas of concern in individual countries (e.g. youth unemployment). A number of project partners have produced national reports examining further this last element (see, for example, ACE, 2000 or IDAE, 2000).

The transport sector is clearly an important omission from the study described here. It fell outside the scope of the study, largely because the types of policy implemented, and the mechanisms by which they may act on employment are significantly different from those in the buildings and industry sectors. A similar study of this neglected sector is therefore needed.

7. IMPLICATIONS FOR POLICY MAKERS

The results of the study provide a broad, positive, up to date picture of the employment benefits of energy efficiency investment programmes. Although employment is not a key aim for energy efficiency policy, it is an argument which can be used to add support for increased activity in this area.

The initial stages of the study identified a number of groups of people for whom unemployment was a particular problem in many countries in the EU. These included the young, those with low skills and women. The case study results identify a clear opportunity to address the needs of one of these groups: people with low skills levels. This is a chance for energy efficiency policy makers to work together with those responsible for areas such as economic regeneration and local sustainable development to combine funding for projects which both improve energy efficiency and transform the employability of the individuals installing the measures involved. This may be a good way to increase the overall level of funding available for energy efficiency work whilst allowing it to make a useful contribution to social as well as environmental sustainability.

Whilst an increase in energy efficiency investment can generate additional employment, it cannot do so if there is no mechanism to provide the labour force with the skills necessary to undertake the work. Therefore, funding already available for training should be utilised as part of any efforts to unite energy efficiency and economic regeneration schemes.

As discussed above, seemingly very similar policies can produce very different employment impacts in different countries. Hence, assumptions should not be made about the suitability of programmes from one country for addressing specific employment issues in another, based solely on the evidence from this study.

However, promising options worthy of further study may be identified. For example, the detailed results of the case studies identify types of direct employment generated by a scheme and the time profile over which this employment is spread. Thus, approaches which demonstrate the potential to provide the right jobs at the right time can be identified and studied further as appropriate.

It should be re-emphasised here that the employment impacts of energy efficiency policies, whilst useful and indeed potentially extremely important in specific cases, are likely to remain a side-effect, rather than a primary reason for action. Hence the amount of additional study of the various options should be rationalised, since decisions between different policy options will in most cases still depend on their effectiveness in terms of delivery against aims such as reduced carbon emissions or improvements to the housing stock.

Although in employment terms it appears desirable for policy to be co-ordinated at the European level, clearly there are other considerations which will limit the extent to which this is possible. However, the results do suggest an additional reason why some degree of common action may be desirable.

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9. REFERENCES

ACE, 2000, *Energy efficiency and jobs: UK issues and case studies*, a report by the Association for the Conservation of Energy to the Energy Saving Trust, London.

Capros P, Paroussos L, Stroubles N, Wade J, Scrase I, Gibson C and Wiltshire V, 2000, *Appendix C: Energy Saving Investment and Employment Analysis Through the GEM-E3 Model*, final report to the European Commission under contract XVII/4.1031/D/97-032, NTUA, Athens and ACE, London.

IDAE, 2000, *Eficiencia Energética y Empleo. El impacto sobre el empleo de las actuaciones en eficiencia energética en España y la Unión Europea*, Instituto para la Diversificación y Ahorro de la Energía, Madrid.

Jeeninga H, Weber C, Mäenpää I, Rivero García F, Wade J, Scrase I, Gibson C and Wiltshire V, 2000, *Appendix B: Employment Impacts of Energy Conservation Schemes in the Residential Sector. Calculation of direct and indirect employment effect using a dedicated input / output simulation approach*, final report to the European Commission under contract XVII/4.1031/D/97-032, ECN, Petten and ACE, London.

Scott S, 1998, *Case study methodology*, final report to the European Commission on task 1.2 under contract XVII/4.1031/D/97-032, ESRI, Dublin.

Wade J, Wiltshire V and Scrase I, 2000, *National and Local Employment Impacts of Energy Efficiency Investment Programmes. Summary report*, final report to the European Commission under contract XVII/4.1031/D/97-032, Association for the Conservation of Energy, London.