Kirklees Warm Zone
Economic Impact Assessment

Final Report
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Prepared for
Kay Beagley, Kirklees Council

Prepared by
Nicola Butterworth, Jo Southernwood and Chris Dunham

Carbon Descent Third Floor 84 Long Lane London SE1 4AU
www.carbondescent.org.uk T 020 7089 6970 F 020 7407 9646

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Executive Summary

Kirklees Warm Zone was clearly a pioneering carbon reduction project. By offering an authority wide free to all cavity and loft insulation scheme, Kirklees have insulated around 51,000 homes – roughly a third of all households - showing that it is possible to increase the level of energy efficient refurbishment activity to approach the sort of scale that would be required nationally to meet the Climate Change Act targets in the domestic sector. But the benefits go beyond the carbon savings into: jobs created, increased economic activity, reduced fuel poverty and improved housing conditions which in turn should translate into improved health and reduced costs to the NHS. Potentially, better energy performance could also translate into a higher perceived house price value. Calculating these wider benefits and translating these into monetary values is the subject of this report.

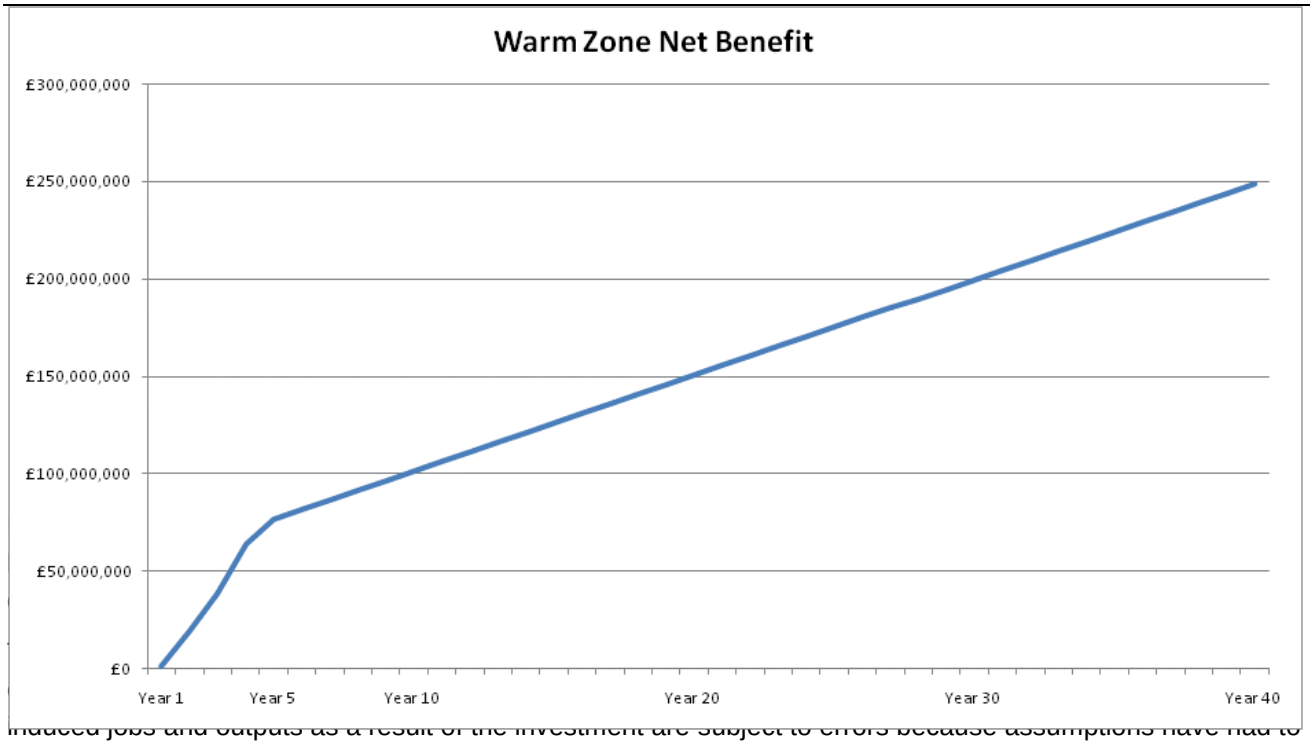
The table below sets out the main findings. From an initial investment of £20.9m of which Kirklees provided £11.7m and Scottish Power the remainder, a net social benefit of almost £250m results – a clear indication that this sort of programme is very worthwhile (the fuel bill savings are shown below undiscounted but also without fuel price inflation – further analysis of this is shown in the main body of the report).

The majority of the benefits, £156m, come about as a result of savings to householders due to reduced energy bills. The overall saving to the NHS of £4.9m looks small in proportion to this but is still significant when set against the initial public sector investment of £11.7m. House value increases are more than the cost of the actual installed measures which may in part show the value of an area based scheme where the cost of measures can be dramatically reduced by operational efficiencies.

	Scheme Costs	Lifetime Fuel Savings (40yrs)	Liftetime CO_2 Savings (40yrs)	Jobs Created & Economic Impact	Saving to NHS	House Value Increase	Confirmed Benefit Claims	Net Benefit (sum of monetised values)
Original Measure	-	4,237 GWh	934 ktonnes	243 FTE	-	5.6 Avg SAP increase		**-**
Monetised Value	-£20.9m	£156.0m	£30.6m	£39.1m	£4.9m	£38.4m	£0.7m	**£248.8m**

Table 1: Kirklees Warm Zone Net Social Benefit

The graph below shows how this net benefit changes over time. Benefits such as the economic stimulus and house price increases will accrue in the the first 3-5 years and the rest accumulate over 40 years. This shows that after 5 years the project net benefit is around £80m (after subtracting the initial spend of £20m) rising to almost £250m over 40 years.



induced jobs and outputs as a result of the investment are subject to errors because assumptions have had to be made about the particular multipliers that should be used, the classification of the initial investment as new or redirected spending and the amount of spending that takes place outside of Kirklees. The estimates of the energy, CO_2 and fuel bill savings are as accurate as they can be without before and after energy monitoring figures but even these are subject to assumptions concerning the reduction factors such as comfort takings associated with a reduction in householder energy bills.

The benefits in terms of the roughly £82m of combined NHS savings, house price value and economic growth probably represent the upper end of the possible values whereas the value of carbon savings and fuel bill savings could easily be higher with more dramatic fuel price rises and revaluations of the economic cost of climate change.

This report has not analysed the efficiencies of the area based approach adopted by Kirklees Warm Zone in detail but according to the scheme contractor, Miller Pattison, – and this is backed up by the highly competitive prices achieved for installation in the Kirklees case – area based schemes can be up to 50% more efficient than the usual scattergun approach. The reason for the greater efficiencies are multiple: greatly reduced travel times, reduced times between jobs, reduced missed calls, greater team efficiency due to constant high work load and ability to purchase materials in higher volumes achieving better pricing.

It should be noted that the figures in this report have not been compared to a counterfactual case (i.e. an analysis of what would have happened in Kirklees anyway if the Warm Zone project had not taken place). Clearly some level of market led insulation activity with and without CERT support would have occurred anyway.

If every local authority in the UK were to implement a similar scheme to the Kirklees Warm Zone, the government would need to significantly increase the CERT (or its successor ECO – Energy Company Obligation) obligations placed on utility companies to ensure that CERT funding is available. Similarly, every local authority would need to set aside the investment for a Warm Zone scheme to ensure that every house in the area could be surveyed and treated with appropriate measures. Scaling the jobs created and economic benefits in Kirklees by population, a nationwide Warm Zone project could bring enormous benefit creating up to 37,000 jobs and boosting the UK economy by up to £6 billion.

Abbreviations

CO_2	Carbon dioxide
CERT	Carbon emissions reduction target
CVD	Cardiovascular disease
CAB	Citizens' advice bureau
CHD	Coronary heart disease
EEC	Energy efficiency commitment
EPC	Energy performance certificate
FTE	Full time equivalent
GVA	Gross value added
HIP	Home information pack
kWh	Kilowatt-hour
KC	Kirklees Council
MWh	Megawatt–hour
NHS	National health service
PCT	Primary care trust
REM	Regional econometric model
RD	Respiratory diseases
RAD	Restricted-activity days
SAP	Standard assessment procedure
SIC	Standard industrial classification of economic activities
VSL	Value of statistical life

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1 Introduction

1.1 Report aims

Kirklees Council (KC) commissioned Carbon Descent to undertake an economic analysis of its three year, energy efficiency initiative, 'Warm Zone'. This concluded in the summer 2010, with final installations completed in November 2010. This widely acclaimed project adopted an innovative authority-wide approach, offering energy efficiency measures free of charge to all residents.

The significant take-up of measures achieved by KC has been recognised by a number of bodies, most recently in the Energy Saving Trust's Carbon Emissions Reduction Target (CERT) funding analysis which, found that with 22.5% of the area's housing stock lagged over the first two years of the CERT scheme, Kirklees had achieved the highest percentage of all British authorities[1]. This unique approach was also awarded the Ashden Award for Sustainable Energy, Local Authority first prize, by HRH the Prince of Wales in 2009[2]. KC decided that the funding resulting from this award should subsidise a broader assessment of the impact of this area-wide approach, providing further quantitative understanding of the project's significance beyond the primary energy efficiency objectives.

This report examines the direct and indirect economic impacts of a number of areas: Job creation, energy saving, health and housing. It provides theoretical return on investment figures based on established methodologies.

1.2 Report structure

Across the three key areas of economic impact, energy and CO_2 saving, and health impacts, each of these chapters will outline the data, the direct impacts collected by KC during the project, suitable methodologies for calculating the indirect and induced impacts of the project and comparison to other studies undertaken. These three areas are complemented by a short discussion on house-price impacts. The conclusion brings together findings from all sections.

1 www.decc.gov.uk/en/content/cms/news/pn10_102/pn10_102.aspx

2 www.ashdenawards.org/winners/kirklees09 - 'championing practical, local energy solutions that cut carbon, protect the environment, reduce poverty and improve people's lives'.

2 Economic impacts

In this section we examine the direct and indirect economic impacts of the Kirklees Warm Zone scheme which includes additional money in the local economy as well as employment impacts.

Kirklees have calculated the direct employment impacts of the scheme in terms of full time equivalent (FTE) jobs at the contractor Miller Pattison, Warm Zone employees at Yorkshire Energy Services, Kirklees Citizens Advice Bureau and Kirklees Council. These jobs will have additional 'indirect benefits' due to companies through the supply chain increasing their output and 'induced impacts' due to income stemming from the original project expenditure being spent in the economy. Widely accepted multiplier methodologies have been used to calculate the indirect and induced impact of the Kirklees Warm Zone and these results are then set against similar studies for comparison. For this study we have used employment and output multipliers released by the Scottish Government for the construction industry which is the category that most closely matches the work undertaken in the Kirklees Warm Zone.

The results of this section are summarised below in Table 2 and show that as a result of the Warm Zone, 243 jobs were created and the economy was boosted by just under £40 million. Every £1 invested in the project resulted in a return to the economy of £1.88. The remainder of this chapter analyses the methodology used to obtain these results in more detail and compares them to other similar studies to provide context.

Contributor		Cost			
Kirklees Council					£11,726,858[3]
Scottish Power					£9,128,004
Total					**£20,854,862**
Total Warm Zone project		**Employment impact**			
	Type	**Multiplier**	**Additional**	**Cumulative**	**Spend per job created**
Direct		1.00	126	126	£165,514
Indirect	I	0.58	73	199	£104,798
Induced	II	0.35	44	243	£85,822
Total		**1.93**	**243**		**£85,822**
Total Warm Zone project		**Output to the economy**			
	Type	**Multiplier**	**Additional**	**Cumulative**	**Spend per £ generated**
Direct		1.00	£20,854,862	£20,854,862	£1
Indirect	I	0.59	£12,309,201	£33,164,063	£0.63
Induced	II	0.29	£5,969,296	£39,133,358	£0.53
Total		**1.88**	**£39,133,358**		**£0.53**

Table 2: Summary of Employment and Economic impact of the Kirklees Warm Zone

2.1 Kirklees Warm Zone direct employment impacts

During the 3 years of the Kirklees Warm Zone 126 FTE posts[4] were created This figure is comprised of the following and is summarised in Table 7 in Appendix 1:

[3] The total eventual Kirklees spend was in fact £11,732,615.91 and £20,860,619.67 was the total scheme cost**,** but the figures used here and throughout the report were the ones available in April 2011 as the calculations were being done.

- Miller Pattison, the project contractor, employed 85 FTE staff to be involved in the delivery of the program as installers or in managerial, technical or administrative roles. The combined salary budget was circa £1.6 million in the first year and £2.1 million for the second and third years
- In addition to the 85 project staff, Miller Pattison also ran a new depot and training centre in Cleckheaton and employed 3 staff to deliver training. There were approx 400 trainees in the first and second years and a further 300 were projected for 2009 -10
- Yorkshire Energy Services, the managing agent for the scheme, employed 11 FTE office based technical, managerial and administrative staff, with combined salaries of £360,000 per year
- Yorkshire Energy Services also employed a pool of around 60 part time self-employed assessors for the first two years and this dropped down to 40 assessors in the third and final year of the project. This equates to approximately 20 FTE staff during the 3 year project[5]. The assessors were paid at £4 an assessment and 133,746 door step assessments were carried out costing a total of £535,020.
- A further 7 jobs (on average over the 3 year project) have been generated or are dedicated to the Warm Zone in Kirklees Council, the Citizen's Advice Bureau, Scottish Power and Safelincs broken down as follows:
    - 2 FTE within the Environment Unit in Kirklees Council
    - 3.5 FTE at the Citizen's Advice Bureau
    - 0.5 FTE at ScottishPower
    - 1 FTE at Safelincs

2.2 Kirklees Council's Initial Calculations

In September 2009 the Economic Development Service at Kirklees Council made some provisional calculations of the job and Gross Value Added (GVA) impacts of the Warm Zone. Based on information collected by project partners, the study found that the Warm Zone directly created over 100 jobs over the 3 year project and indirectly created an additional 29 jobs per year (Type I multiplier of 1.23) as "*a result of the extra spending generated and spent in the local economy*"[6].

This analysis employed the following assumptions in relation to the base employment data outlined above:

- The project lasted 3 years from 2007-2010
- All benefits accrue to Kirklees i.e. there is no leakage of benefits to regions outside Kirklees. (Although this is unrealistic it was felt that this was appropriate for this level of modelling)
- No displacement effects, leakages or skills constraints were considered
- Trainees that attended Miller Pattison's training centre at Cleckheaton were not regarded as FTE employees
- The sectors that have been apportioned project employees include Gas, Electricity & Water, Construction, Public and Other Services.

The Gross Value Added (output) to the Kirklees economy (in addition to the direct funding for the Warm Zone) was estimated for each year of the project:

- 2007/08 = £9.34 million

[4] From data sent to Carbon Descent by email by Bethan Sheridan-Jones, Chief Economist at Yorkshire Forward. Email sent on Thursday 28th October 2010 at 12.48, data contained in an attachment entitled "Economic multipier KWZ sent 22_09_2010.

[5] Assuming each assessment takes 15 minutes to complete and a FTE would work 7 hours a day for 210 days per year.

[6] www.kirklees.gov.uk/community/environment/green/pdf/WZCaseStudyWithJanuaryFigures.pdf from www.kirklees.gov.uk/community/environment/energyconservation/warmzone/warmzone.shtml

- 2008/09 = £9.06 million
- 2009/10 = £8.61 million

The total economic impact of the project was estimated to be over £80 million through a combination of the direct funding, extra spending in the economy through job creation, savings on householder fuel bills and increased uptake of benefits by Kirklees residents as a result of advice given to householders. This equates to a return of approximately £5 for every £1 invested in the Warm Zone.

These figures gave an initial view of the possible economic impacts of the project but it is the purpose of this report to review and update these provisional figures and assess the wider economic impacts.

2.3 Background to economic multipliers

Many Governments use 'input-output' matrices to model all industry sectors' contribution to the economy as well as the sourcing patterns between industries. Input-output matrices are models of entire nations' economies and although the calculations are fairly simple they are also hugely onerous in terms of data collation as they require input from many sectors. One output of these models is a series of economic multipliers which indicate the impact on the economy from a unit change in final demand.

These models work on three basic principles[7]:

- The economy is stimulated through a change in final demand (i.e. if demand for a product increases there will be an increase in the volume of that product being made as producers react to meet the increased demand
- A chain of spending and re-spending is set into motion by an initial economic stimulus (i.e. higher demand for a product means producers & their suppliers need to employ more people and those employees will spend more money on other products)
- The notion of 'leakage' from a local economy (i.e. money spent locally may not remain in the local economy but could be spent elsewhere in the country or abroad)

There are a number of multipliers that can examine different aspects of an investment such as employment, income or output. The key definitions associated with such multipliers are outlined below:

- **Direct effects:** If there is a change in demand for a particular product or service, the producers will react to meet this increased demand (e.g. they may need to employ more people or make more products). This is known as the direct effect.
- **Indirect effects:** In order for producers to increase their product output, they will also place extra demands on their suppliers and the rest of the supply chain who will in turn react to meet this increased demand. The impact of the change in demand on the supply chain is known as the indirect effect.
- **Induced effects:** The impact of the direct and indirect effects is to increase the level of household income through increased employment. Some of the increased income will be re-spent on final goods and services and this is the induced effect.
- A **Type I** multiplier accounts for the Direct and Indirect effects
- A **Type II** multiplier accounts for the Direct, Indirect and Induced effects
- An **employment multiplier** looks at the change in employment resulting from the investment or change in final demand and is defined as "*the ratio of direct plus indirect (plus induced if Type II multipliers are used) employment changes to the direct employment change"*[8]

[7] www.cdtoolbox.net/economic_development/000149.html

[8] www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/Mulitipliers

- An **income multiplier** looks at the change in income resulting from the investment and is defined as "*the ratio of direct plus indirect (plus induced if Type II multipliers are used) income changes to the direct income change*"[9]
- An **output multiplier** looks at the change in output resulting from the investment and is defined as "*the ratio of direct and indirect (and induced if Type II multipliers are used) output changes to the direct output change due to a unit increase in final demand*"[10]. Outputs

A summary of the different types of multiplier and how they might apply to the Kirklees Warm Zone can be found in Appendix 1 Table 8.

To illustrate the principle of multipliers within the Kirklees Warm Zone context, one of the direct impacts of the project was to create 88 jobs at Miller Pattison. The indirect impact of the investment is that Miller Pattison purchased more loft and cavity wall insulation from an insulation manufacturer who may also have had to take on more staff to cope with this increase in demand. As a result of this, the insulation manufacturer would have had to purchase more raw materials and more packaging for the product which in turn could have created more jobs at their suppliers and so on throughout the supply chain. The number of direct and indirect jobs created through the supply chain can be estimated by multiplying the number of jobs created directly at Miller Pattison by a Type I employment multiplier.

To take this example a step further, the direct and indirect jobs created would cause an induced effect in other companies. This is because those that had been additionally employed through the Warm Zone supply chain would have more money available to spend on goods and services (assuming that they had previously been unemployed) which would increase demand on other companies and hence create more jobs. The total number of direct, indirect and induced jobs created by the project can be calculated by multiplying the number of jobs created directly by the Warm Zone by a Type II employment multiplier.

2.4 Analysis of available economic multipliers

Each industry has its own economic multipliers associated with it (an increase in final demand for soft drinks will not generate the same growth in the economy as an identical increase in final demand for clothes for example). Therefore, when selecting a multiplier to apply to the Warm Zone it is important to choose the figures that are most closely associated with the installation of insulation to ensure the economic benefits are not over or understated.

Multipliers can be used at a national, regional or local level. It is important to note that for a particular industry the multiplier would change when considering the impact of that activity at a national level versus a regional or local level. This is due to the possibility that input goods and services may be sourced from outside the region in question. At a national level, the impact of this leakage is likely to be minimal as there are fewer things that would need to be sourced abroad. However, a local or regional project is likely to need to source materials, goods or services from other parts of the country therefore the national multipliers are likely to overstate the economic and employment impacts if applied to a specific area.

2.4.1 Scottish Government Economic Multipliers

The UK Office for National Statistics previously compiled economic multipliers for England annually; however, since 1995 they have not done so due to changes in the format of import and export data. The publication will be reinstated in 2011[11]. The Scottish Government has more recent data with multipliers from 2004 available[12] for the industries covered by the UK Standard Industrial Classification of Economic Activities 2003 – SIC(2003). Category 45 – 'Construction' – is the one that fits most closely to the work carried out in the Kirklees Warm Zone as it includes sub-category 45.3- Building Insulation (Note: multipliers are not available for individual sub

9 www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/Mulitipliers

10 www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/Mulitipliers

11 Personal Communication, email dated 30/09/2010: Charlotte Smart, Supply-Use Production, National Accounts Coordination and Development Room 2.101, Office of National Statistics

12 www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/Mulitipliers

categories, only for each main SIC category)[13]. Table 9 in Appendix 1 shows the Type I and Type II Output, Employment, Income and Gross Value Added multipliers released by the Scottish Government for 2004.

2.4.2 Other Economic Multipliers

Several studies have been conducted to determine economic multipliers for a variety of projects including the following:

- Crossrail - A predictive national multiplier based on other studies and Scottish Government figures for construction, with leakage abroad based on a range of multipliers of between 1.33 and 1.86
- Association for the Conservation of Energy, Employment in Energy Efficiency, Integrating energy efficiency with the social agenda in sustainability – A predictive multiplier for impacts of domestic heating and hot water energy efficiency upgrading schemes in England based on previous studies
- Modelling the North East Economy: The Impact of Fuel Poverty Intervention on Economic Activity in the North East of England – A retrospective regional multiplier for an energy efficiency scheme from Durham University's economic model
- Yorkshire Forward Regional Econometric Model – Based on the Construction Industry National figures from Experian (no displacement), Construction industry regional figures from Yorkshire Forward (no displacement) and the Kirklees Warm Zone

The multipliers cited in the studies listed above are all based on Type I multipliers only and can be found in Table 10 in Appendix 1. The employment multipliers that they predict range between 1.17 (Association for the Conservation of Energy) to 1.61 (Kirklees Regional Econometric Model based on Regional Construction Industry Figures) so clearly the figures are very sensitive to differences in the areas covered by the study and the industry being examined.

2.5 Choosing a multiplier

For the purpose of this study we have chosen to use the Scottish Government Economic Multipliers for SIC Category 45 – Construction. The reasons for this decision are as follows:

- These are official, national figures for the broad economic classification in which energy efficiency measures sit. Although they are for Scotland it is unlikely that they will be significantly different to figures for England or the UK in general because of their proximity in terms of distance and the similarity in their economies. Figures due to be published by the UK government in 2011 may allow more accurate analysis to be conducted at a later date.
- Of the studies examined this is the only source that provides multipliers for both employment and output. This allows the prediction of both the impact of the project on the creation of jobs and the impact in financial terms on the economy.
- The multipliers are national rather than local meaning that they show the complete impact of the Warm Zone project nationally rather than just the local impacts. It should be noted therefore, that the indirect and induced benefits created by the Warm Zone do not relate entirely to Kirklees but include benefits to the economy in other areas of the country.

A further point to note is that these multipliers relate to new spending in the construction industry rather than redirected spending. This is an important difference because in the case of a redirection of funds, only the additional jobs or spending created on top of those that would have been created anyway through the original investment should be counted when assessing the benefits of the project. As the Kirklees Warm Zone project involved a redirection of spending, the figures given here should be taken as the upper limit of the benefits brought about by the project.

[13] www.statistics.gov.uk/methods_quality/sic/downloads/UK_SIC_Vol1(2003).pdf and 2007/2010 www.statistics.gov.uk/methods_quality/sic/downloads/SIC2007explanatorynotes.pdf

2.6 Key Results

2.6.1 Jobs created as a result of the Warm Zone project

As described earlier in this chapter, the number of FTE jobs created by the Warm Zone project is known to be 126. Using the Scottish Government employment multipliers for SIC Category 45 – Construction, an additional 73 jobs were created through the supply chain of the project partners and a further 44 jobs were created in other industries as a result of the additional spending by those employed in the Warm Zone supply chain. In total the Warm Zone project created 243 jobs the majority of which were located in Kirklees with the remainder being spread though other regions. A summary of the multipliers used to calculate these figures is given in Table 11 in Appendix 1.

2.6.2 Economic impact of the Warm Zone investment

As the amount that has been spent on the Warm Zone is known, it is possible to calculate the impact that this investment has on the economy by using output multipliers. Output multipliers predict the impact that an increase in final demand for a product or service will have on the wider economy. For example, if a company decided to build new premises and paid a construction firm £1 million to build it the boost that this would give to the economy is more than the initial £1 million investment. This is because the construction workers who build the new property might spend say 50% of the money they receive on other goods and services (e.g. food, drink, clothes, new cars etc). Those providing those goods and services in turn spend 50% of the money they receive on other goods and services, and so on through the supply chain. The value of every transaction in this chain is counted as a boost to the economy, so the initial £1 million investment is spend and re-spent many times over and it is the sum of these transactions that gives the final impact on the economy. If, as in this example, everyone spends 50% of the money they receive on other goods the boost to the economy would be £2 million – twice the initial investment – and the output multiplier in this case would be 2.

The total amount invested in the Warm Zone project by Kirklees Council and Scottish Power is £20,854,862 and as this was paid to the project partners responsible for delivering the scheme, this equates to a direct increase in output of £20,854,862. The Scottish Government gives figures for Type I and Type II output multipliers for the construction industry and using these multipliers (given in Table 9, Appendix 1) gives the following results:

- The indirect impact of the investment is an additional £12,309,201 of indirect spending in the Warm Zone supply chain
- The induced impact is an additional £5,969,296 of induced spending of those in the supply chain for the purchase of other goods and services
- The total increase of spending in the economy is £39,133,358 meaning that every £1 invested returns £1.88 to the economy as a result of additional spending and re-spending.

A summary of these results is given in Table 11, Appendix 1. The figures above relate only to additional spending as a result of the jobs created by the investment. They do not take into account the savings made through a reduction in energy bills of the households that received the insulation measures, the health benefits that were brought about by bringing people out of fuel poverty, the increased uptake of benefits as a result of advice given to householders or the possible increase in the value of homes in Kirklees.

Of the £20,854,862 invested, Kirklees contributed £11,726,858. Repeating the analysis above to show the impact of the Kirklees investment only gives the following results:

- The indirect impact of the investment is an additional £6,738,360 of indirect spending in the Warm Zone supply chain
- The induced impact is an additional £3,267,740 of induced spending of those in the supply chain for the purchase of other goods and services
- The total increase of spending in the economy is £21,422,565 meaning that every £1 that Kirklees Council invested returns £1.88 to the economy as a result of additional spending and re-spending.

A summary of these results are given in Table 12, Appendix 1.

The match funding provided by Scottish Power was clearly critical to the scheme going ahead in the form it took. However analysing the figures from the point of view of Kirklees Council, the £11,726,862 invested by Kirklees resulted in a boost to the economy of £39,133,358 i.e. every £1 invested by Kirklees, returns £3.34 to the economy.

2.6.3 Value for Money

The Warm Zone project created a total of 243 jobs throughout the economy taking into account direct, indirect and induced jobs generated at a total cost of £20,854,862 meaning that a job was created for every £85,822 invested. Taking just the Kirklees contribution into account, a job was created for every £48,258 of investment by Kirklees council with each job lasting for the three year duration of the project on average. A further breakdown of these costs is given in Table 13 in Appendix 1.

2.6.4 Ancillary Schemes

In addition to the Warm Zone there are several other schemes running in Kirklees that help householders reduce their energy bills including:

- Warm Front – the national scheme offering free insulation and free central heating to what the government considers 'priority' households – those on means tested benefits.
- Warm Homes – a Kirklees funded scheme for households on a low income, not on benefits, in extreme fuel poverty – greater than 15% or with exceptional health needs.
- Affordable Warmth – a regional West Yorkshire Housing Partnership scheme – grant for boiler replacements and central heating for homes which should have been Warm Front eligible but for whatever reason would not get a Warm Front grant, or homes on benefits in urgent need or with exceptional health needs.

Warm Zone assessors sometimes referred householders on to one or more of these ancillary schemes where appropriate which could have resulted in an increase in uptake for the other schemes. The number of jobs created and the economic outputs of referrals from Warm Zone to ancillary schemes has not been considered in this study because there was not sufficient data available to determine the number of direct jobs created as a result of referrals. Similarly the amount of additional spending that occurred through ancillary schemes as a result of referrals is not accurately known so an assessment of the economic impact of these referrals has not been made here. Another point to consider is whether the referrals from the Warm Zone assessors to ancillary schemes would have been counted as additional clients or whether they would just have displaced another household that would have received help anyway. In the case of displacement, the referrals would not have created any new jobs or economic benefits as the spending would have occurred anyway.

2.7 Sensitivity analysis from comparative studies

As discussed earlier in this chapter there are a range of studies that quote employment and output multipliers for different regions and industry sectors. The Scottish Government Employment multipliers used above give the highest estimate of the number of jobs created of all the multipliers given in Table 10 in Appendix 1, with a Type I employment multiplier of 1.58. The lowest estimate is given by the Association for the Conservation of Energy which used a Type I employment multiplier of 1.17.

Further detail of the sensitivity analysis is given in Table 14 in Appendix 1.

2.8 Discussion of findings

For the purposes of this analysis we have examined the impacts of jobs created in the year that they occurred. If we were to look at the impact of the project beyond its completion further analysis would be needed on the lifetime of these jobs. There is some discussion in the literature about the longevity of a full-time equivalence, the EU says *"the length of a full-time job has changed through time and differs between industries, methods*

which establish the average proportion and average hours of less than full-time jobs in each job group have to be used"[14]*.* Currently the EU requires that jobs created as a result of EU funding should last for at least 1 year beyond the end of the funding. In the literature, Goodacre refers FTE jobs as lasting for 15 years and Clinch 10 years which is the same as DEFRA's current definition[15]. More appropriate to this style of analysis is the approach by other councils, such as Somerset[16], which use 1 year.

It is interesting to note that in fact many of the direct jobs have continued beyond the lifetime of the Warm Zone scheme. Miller Pattison still have 42 staff employed at the Cleckheaton site, and Yorkshire Energy Services still have 10 of the 11 staff recruited and have now got an additional 3 FTEs from the 60 p/t assessors.

It is important to note that we have not considered the additionality of the Kirklees Warm Zone impacts. English partnerships[17] define net additional impact as impact of intervention less impact of reference case (termed, 'deadweight'). We do not have access to a counterfactual case for the Kirklees Warm Zone and have instead calculated the total impact of the project. As discussed earlier in this section employment and economic benefits presented here should be taken as an upper limit because they assume that the initial investment was new spending even though it is likely that at least a proportion of the funds would actually have been redirected from other projects.

Despite the short term nature of the scheme and the uncertainty over the possible over estimate of the benefits it is clear that the Kirklees Warm Zone Scheme delivered significant benefits to the local economy. 126 jobs were created as a direct result of the programme and it is likely that up to 117 more were created in their supply chain and throughout the UK. Every £1 invested in the project returned up to £1.88 to the UK economy. A large proportion of this is likely to be of local benefit because the 126 additional jobs created directly would have been within Kirklees so much of the additional spending as a result of these jobs was likely to have taken place locally. Scaling by population, if all 433 local authorities in the UK invested up to £12 million in a Warm Zone project with approximately £9 million worth of match funding from energy suppliers (as Kirklees have done) there is the potential to create approximately 37,000 jobs nationwide. Such a scheme could boost the economy by approximately £6 billion (again assuming Kirklees figures are scaled by population).

[14] circa.europa.eu/irc/dsis/nfaccount/info/data/esa95/en/een00473.htm

[15] www.defra.gov.uk/rural/documents/rdpe/guidj.pdf Definition of the indicator: Net additional Full Time Equivalent (FTE) jobs created

[16] www.somerset-rural-renaissance.co.uk/pdf/SWRDA%20output%20definitions.pdf

[17] p3 A Standard Approach to Assessing the Additional Impact of Projects Method Statement Second Edition September 2004

3 Energy and fuel bill saving impacts

In this section we examine the householder energy, carbon and fuel bill savings achieved by the Kirklees Warm Zone. The core objectives of the Warm Zone are to reduce carbon emissions and, by reducing fuel bills, to tackle fuel poverty. This analysis assists in the quantification of that impact.

Whilst it might be imagined that calculation of energy savings and carbon emissions should now be a relatively straightforward undertaking, there is still some debate over issues such as level of 'comfort taking' i.e. the amount of predicted energy saving and the performance of insulation in practice. For this assessment we have used the Ofgem/CERT assumption that only 50% of the predicted energy saving for an improvement in insulation is achieved in practice - due to reduction factors such as uneven installation of insulation and 'comfort taking' i.e. people heating their homes to a higher temperature after insulation has been installed because they can afford to do so.

There are a number of options as to how to calculate the energy and carbon savings. We have utilised a process based on Kirklees Council's own energy database but adjusted for reduction factors and updated fuel prices. Ofgem's CERT methodology which Scottish Power use to calculate carbon savings is an equally valid process and produces very similar results.

The results of this analysis show that in total the Kirklees Warm Zone resulted in:

- energy savings of just under 106,000 MWh per year
- a reduction in CO_2 emissions of 23,350 tonnes per year
- a reduction in fuel bills of £3,900,722 per year

A summary of these results is given in Table 3. For all calculations, the lifetime of the insulation measures installed has been assumed to be 40 years. Over the project lifetime the net present value of the investment is £128,650,976 assuming a discount rate of 3.5% and a rate of inflation of fuel prices of 5%. Using these figures the rate of return on investment over the 40 year life of the measures installed is very favourable at 23.7%.

It should be noted that the return on investment applies to the Kirklees community as a whole and not just Kirklees council because although the initial investment was made by the council, the fuel bill savings benefit the individual householders.

The remainder of this chapter analyses the methodology used to carry out these calculations in more detail and compares these results to other similar studies.

		Annual savings not including reduction factors	Annual Savings including reduction factors	Lifetime of measures (years)	Cost of one unit of impact including comfort savings over life of measures (£)
Energy savings	**(GJ)**	762,514	381,257	40[18]	£1.37/GJ
	(MWh)	211,826	105,913	40	£4.92/MWh
Emissions savings	**(tCO_2/yr)**	46,700	23,350	40	£22.33/tCO_2
Fuel bill savings	**(£)**	£7,801,445	£3,900,722	40	£0.13/£saved

[18] In fact the first 9 months of the scheme was delivered under EEC2 – the forerunner to CERT - where lifetime for loft insulation was 30 years rather 40 but this was increased to 40 under CERT

Project Spend	£20,854,862
Net Present Value	£128,650,976
Internal Rate of Investment	23.7%

Table 3: Summary of energy, carbon emissions and fuel bill savings resulting from the Warm Zone

3.1 Methodology

There are two existing sources for the calculation of energy savings: Kirklees' Maxim database and Scottish Power's CERT reporting. Our analysis uses the Maxim dataset provided by Kirklees Council but applies assumptions used by CERT to this data. This database is populated with the Warm Zone survey data collected during the doorstep surveys. In addition, it contains information as to what measures were installed in each property treated through the scheme. In theory this data source provides a more accurate basis for calculating the energy and carbon savings as the calculation is made at the level of each individual property based on the data collected about that property including heating system and fuel type. However it does rely heavily on the data collected during the surveys being accurate. The Maxim database also estimates the SAP improvement which has been used to calculate the increase in house value in section 5.

There are however a number of disadvantages with the Maxim calculations:

- The SAP based methodology that underlies the Maxim calculations makes no allowance for reduction factors such as comfort taking. This is taken into account by Ofgem's CERT reporting methodology. Ofgem reduces the predicted saving by 50% for CERT (for WarmFront the reduction is even higher - 65%). The CERT correction is made up of 15% comfort taking – a reduction due to part of the saving being taken in increased internal temperatures - and a further 35% due to underperformance of insulation[19].
- The assumed fuel and electricity prices are several years out of date in Maxim so the cost savings to householders are not reliable

In order to address these shortcomings, the process of calculating the impact of the Warm Zone on energy and fuel bill savings has therefore been as follows:

1. Extract the energy and CO_2 savings from Maxim
2. Check the emission factor assumptions used by Maxim
3. Calculate updated electricity and fuel prices
4. Recalculate the financial savings to the householder based on the corrected energy savings with updated electricity and fuel prices.
5. Apply a 50% reduction factor to energy, cost and CO_2 savings (as per CERT)
6. Apply discount rates and inflation to model the net present value of the scheme over its lifetime.

3.2 Analysis

3.2.1 Energy and CO_2 Savings from Maxim

The Maxim dataset shows that unsurprisingly the dominant heating fuel is mains gas which supplies 96.6% of the energy used for heating. Off peak electricity was the next most common heating fuel (supplying 1.4% of heating energy) with the remainder being split between less common heating fuels such as smokeless fuel, oil

[19] www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/InfProjMngrs/Documents1/TM%20Guidance.pdf For a fuller description of these issues see Appendix 4.

and peak electricity. A full breakdown of heating fuels is given in Table 15 in Appendix 1. This analysis shows that the Warm Zone resulted in the following energy and carbon emissions savings:

- Energy saving of 762,514 GJ of energy per annum (almost 212 million kWh)
- Emissions reduction of 46,700 tonnes of CO_2 per annum

3.2.2 Calculating Financial Savings

In order to calculate the financial savings resulting from the reduced energy bills, an average price for the unit cost of all fuels used by the households treated under the Warm Zone was needed. DECC provides quarterly energy price projections for gas and electricity for a small number of UK cities broken down by different payment methods. As Leeds is the closest geographically to Kirklees this has been used for the analysis. The mix of payment methods in Yorkshire is taken from the same report to calculate an average gas and electricity price for households in Kirklees of 3.6406 p/kWh and 12.1141 p/kWh respectively. Table 17 and Table 19 in Appendix 1 show the figures extracted from DECC to carry out these calculations. The unit cost of other fuels was taken from SAP 2009 and a full breakdown of these costs is given in Table 20 in Appendix 1.

Multiplying the energy saving for each fuel type given by Maxim by the unit cost of each fuel gives the cost savings achieved by the project. The total savings on household fuel bills comes to £7,801,445 per annum. This figure is broken down further in Table 20.

3.2.3 Applying Correction Factors

As discussed above, Ofgem apply a correction factor to the energy savings of 50% to account for comfort takings. Once this is applied to the figures given above the total savings drop to the following levels:

- Energy saving of 381,257 GJ of energy per annum (almost 106 million kWh)
- Emissions reduction of 23,350 tonnes of CO_2 per annum
- Reduction in energy bills of £3,900,722 per annum

A full breakdown of the savings by fuel type is given in Table 21 in Appendix 1.

Strictly speaking the correction factor should not be applied to the savings from hot water tank jackets but as this represents less than 0.5% of the total savings achieved it will not be significant.

The correction factor clearly has a huge impact on the overall saving but it is worth noting that part of this reduction is effectively realised in more comfortable conditions and better health so whilst it has been removed here, some of the impact will be accounted for in savings to the NHS which is the subject of section 4.

A further indicator of the financial benefit of the project is the cost per unit of benefit achieved. Over the 40 year lifetime of the insulation measures:

- the cost per tonne of CO_2 saved by the Kirklees Warm Zone is £22.33.
- the cost per MWh of energy saved is £4.92

A breakdown of these calculations is given in Table 18.

3.2.4 Net Present Value & Internal Rate of Return

The payback period of the Kirklees initial investment is 5.3 years if calculated using the simple payback method. To calculate the return on the Kirklees investment over the life of the project we have carried out a net present value (NPV) analysis which shows that at 40 years (the assumed lifespan of the insulation products installed) the NPV is £128,650,976 and the internal rate of return on investment is 23.7%. A discount rate of 3.5% has been used as this is the Treasury Green Book recommended value for public sector investment. Fuel price inflation is more difficult to predict over a 40 year period but we have assumed that fuel prices will rise by 5% per year on average. Using this method shows that the investment will breakeven during the 3rd year after installation. A sensitivity analysis around these assumptions is shown in section 3.3. A summary of the figures and the assumptions made in this analysis is given in Table 22 in Appendix 1.

These results represent a community NPV and return on investment because the investment was made by Kirklees Council and Scottish Power but the savings accrue to the householder. The results show that the measures are still excellent value for money even when including only the householder energy savings. The community is making a substantial profit over 40 years whilst saving carbon.

3.2.5 Monetising CO_2 Savings

Translating CO_2 savings into a financial value is regularly done as part of this type of cost benefit analysis. This involves translating the avoided environmental damage from avoided carbon emissions in the future to a current value per tonne of CO_2 or Carbon. This is sometimes known as the "social cost of carbon". The UK government pioneered an approach whereby a "social cost of carbon" was to be used of £70 per tC and rising at £1 a year. This was updated and summarised in a paper for the OECD[20]. This paper gives a mean value for the period 2010-2050 of £100 per tC. One tonne of Carbon equates to 3.67tonnes of CO_2. The overall saving is therefore £30,567,535 in terms of avoided environmental damage from climate change.

3.3 Sensitivity analysis & comparison to other studies

The CERT methodology which Scottish Power (must) use to report carbon savings to Ofgem is based on a model of the UK housing stock produced by BRE. In this model dwellings are classified into a number of different subtypes. BRE have then calculated the carbon savings associated with individual measures applied to those subtypes based on the average mix of heating fuels in the UK and assumptions about efficiency etc.

Using this methodology gives a good correlation with those calculated using Maxim. Scottish Power calculated that 22,679 tCO_2 per annum had been saved which is just 2.9% lower than the figure of 23,350 tCO_2 per annum calculated above. Lifetime CO_2 savings calculated by Scottish Power were 3.4% lower than those calculated here, again showing good agreement between the two studies. A breakdown of these figures is given in Table 23.

The effect of varying discount rates and fuel price inflation on NPV and IRR has also been assessed to determine the sensitivity of the investment to changes in external conditions that cannot be influenced by Kirklees. Using a private sector discount rate of 10% but assuming that fuel prices continue to increase at 5% per year reduces the NPV by almost two thirds. By increasing the annual fuel price inflation assumption from 5% to 10% whilst maintaining a discount factor of 3.5%, the overall NPV is also increased from £129m to £301m. A further breakdown of this analysis is given in Table 24.

Table 25 shows results from comparable studies of in terms of costs, savings and payback periods. These studies have a ratio of lifetime value of energy savings to total project cost of between 0.9 and 5.2 and payback periods ranging from 4 years to 10 years. All the studies examined here relate to project that involve the installation of energy conservation measures particularly in relation to heat. The Kirklees Warm Zone has a payback period of 5 years and (assuming the lifespan of the insulation is 40 years) an energy saving to cost ratio of 7.5 which compares very favourable to these other studies.

3.4 Discussion of findings

The analysis above show that a substantial saving has been made in terms of the energy, CO_2 and fuel bill savings brought about by the Warm Zone project. On average just over £400 was spent on each property that was treated and this investment resulted in a reduction in fuel bills of £76 per annum per household. The payback period in this case is just over 5 years.

The high financial returns on investment are largely due to the efficiency of the Warm Zone scheme and the low cost of installation per household. This was achievable because of the economies of scale associated with treating as many properties in the same area as possible. Running the scheme in this way meant that there

[20] http://www.oecd.org/dataoecd/19/21/37321411.pdf

were less travel expenses of installers and contactors to pay and less time wasted travelling between jobs. This is certainly supported by the comparison with other studies of a similar nature which shows that the Kirklees Warm Zone achieved a lifetime fuel bill saving to project cost ratio of 7.2 – higher than any of the other studies found on this subject. This comparison is shown in Table 25 in Appendix 1. There are two obvious candidates to explain this:

- The increased efficiency of a well run concentrated area scheme with high levels of uptake
- The particular cost effectiveness of the measures selected

It should be noted that the financial benefits do not go directly to Kirklees Council but are spread through the community because although Kirklees Council made the initial investment, it is individual householders that benefit from the reduced energy bills. Therefore the figures presented above should be viewed as a total benefit to the community rather than a direct benefit to Kirklees Council.

The saving on fuel bills would have resulted in many households having more disposable income available to spend on other goods and services. Assuming that the majority of this additional money would have been re-spent in Kirklees the benefits to the local economy could be more significant than simply the total amount of money saved on fuel bills. As in the previous section, output multipliers could be used to calculate the potential boost to the Kirklees economy as a result of this additional disposable income but selecting a multiplier would be more complex as the savings go to households and so cannot be attributed to one particular industry or another. It is therefore outside the scope of this project to undertake this analysis.

4 Associated impacts - health

In association with the local Primary Care Trust (PCT), the Kirklees Warm Zone prioritised those householders whose health is at risk from cold and damp housing. During the doorstep assessments information was gathered from respondents on the condition of their homes, health of the occupants, and benefits claimed. 133,746 homes were assessed, 94,788 homes were surveyed and many of these took up advice on benefits, debt and health. Kirklees Citizens Advice Bureau calculated that an estimated additional £1.648 million of benefits were claimable as a result of the advice given to residents. 287 households out of the 868 residents that were advised that they were eligible for additional benefits have had their claim confirmed by the CAB with an average gain of £2,552 per annum with total confirmed benefits so far of £0.732 million.

It is important to include an estimate of the money saved by the NHS through the Kirklees home insulation scheme, as research has identified clear links between condensation and mould caused by high humidity in cold housing and negative impacts on health, in terms of both mental and physical wellbeing. This holistic approach to quantifying the benefits of an area-wide scheme across a range of indicators ensures that all improvements are captured, Christine Liddell Chris Morris and Susan Lagdon, University of Ulster have carried out a review of the relevant literature and a preliminary cost- benefit analysis of health and wellbeing impacts, including those that are not directly attributable to Kirklees Warm Zone, estimates benefits to the NHS of £4.853 million.[21]

4.1 Kirklees health

The last census in 2001[22] found that the health of Kirklees residents closely mirrored the national results with 18% reporting a long term illness (compared with 18.2% for England and Wales). However, in response to the census question, 'Over the last twelve months would you say your health has on the whole been Good, Fairly Good, or Not good?', the Kirklees population self-reported a slightly worse state of health than the national average. 67.7% of people in Kirklees reported Good (against 68.6% in England and Wales) and 9.8% Not good (against 9.2% in England and Wales). A further breakdown of health statistics in Kirklees is given in Table 26 in Appendix 1.

4.2 Health Cost –Benefit Analysis

An analysis drawing on two models – the first phase of the DECC HI- DEEM model (London School of Tropical Hygiene 2011) and a model developed by the University of Ulster (Liddell 2009) has been carried out to review the value of the health and well-being impacts of the Kirklees Warm Zone.

The evidence base indicates that a holistic retrofit is required, ie: including heating measures, for impacts to be seen on physical health of residents as well as mental health. The Ulster review includes estimates of savings to the NHS as a result of the following measures - insulation, heating, fire safety checks installing smoke alarms and carbon monoxide monitors.

In essence the Kirklees Warm Zone estimated savings to the NHS are £4.853 million. The Ulster review summarises as follows:

"In the context of the Kirklees Project, most of the interventions consisted of loft insulation either with or without cavity wall insulation. Given the evidence base cited above, it is unlikely that the bulk of installations will have yielded clinical impacts on the physical health of residents; instead impacts were likely to have been largely confined to improvements in mental wellbeing as a result of –

- better thermal comfort,

[21] Kirklees Warm Zone The project and its impacts on well-being, Christine Liddell, Chris Morris and Susan Lagdon, 2011.

[22] www.statistics.gov.uk/census2001/profiles/00CZ-A.asp and www.kirklees.gov.uk/community/statistics/keystatisticsreport.pdf. Accessed 7th October 2010

- reduced utility bills
- improved home safety following fire checks and the installation of smoke alarms and carbon monoxide detectors.

Consequently, in calculating health impacts focus is primarily on the benefits associated with mental wellbeing”

5 Housing

In this section we explore the possible impacts of the home insulation installed through the Kirklees Warm Zone scheme on property values.

A rudimentary Standard Assessment Procedure (SAP) home energy efficiency rating was calculated by KC for all properties that were assessed as part of the Kirklees Warm Zone program. For all properties that took up measures, a subsequent SAP rating was calculated. Combining this improvement in energy rating with estimated impact on property prices the overall potential on impact on property prices (in today's terms) has been calculated.

Criteria	Value
Number houses with improved SAP rating as a result of Warm Zone	48,596
Average % improvement in house prices	0.67%
Average Kirklees property price	£117,336
Average increase in value per property	£790
Total Increase in value of housing stock	**£38,377,179**

Table 4: Summary of average increase in property prices due to Warm Zone measures

5.1 Impacts of home insulation on house prices

SAP is the UK Government's recommended methodology for measuring the energy performance of a building and "*typically reflects the theoretical annual energy costs per unit of space*"[23]. An Energy Performance Certificate (EPC) uses roughly the same methodology but is termed a 'Reduced Data SAP', the accuracy of which is ±5 SAP points. An EPC (energy efficiency rating and accompanying recommendation report) forms part of a Home Information Pack (HIP) required whenever a dwelling is sold or there is a change of tenants. A SAP calculation for the property produces a score between 0-100 and this can then be given an energy efficiency rating from A-G needed for the EPC. This rating will outline the current as well as the potential energy efficiency of the dwelling. The EPC ratings are valid for 10 years, but if a property owner has improved the energy performance of the home during that time, they may choose to acquire another rating if they are selling their property or changing tenants. In theory, over time the Government will require houses bought and sold to adhere to higher minimum energy rating, thereby driving reductions in the future carbon emissions of the housing stock.

Surprisingly little research has been undertaken specifically on the impact of energy or eco labelling on house prices. Research conducted in 2010 on the Dutch housing stock[24] who under the European Building Directive also introduced EPCs, found that the price-premium buyers are willing to pay for an energy-efficient A-rated property was 12% (over an G-rated property), more than just the value of future energy savings.

In the graph below from the Dutch study, the solid line reflects the time trend in the transaction premium for dwellings with a "green" label (A, B, or C) relative to dwellings with label D or lower. The dotted line represents the transaction volume of 'green'-labelled dwellings (energy labelling was not mandatory at the time and the adoption of labels actually fell during that time.)

[23] standardassessmentprocedure.com/

[24] On the Economics of Energy Labels in the Housing Market, Brounen, Dirk and Kok, Nils, 2010. Available at SSRN: http://ssrn.com/abstract=1611988

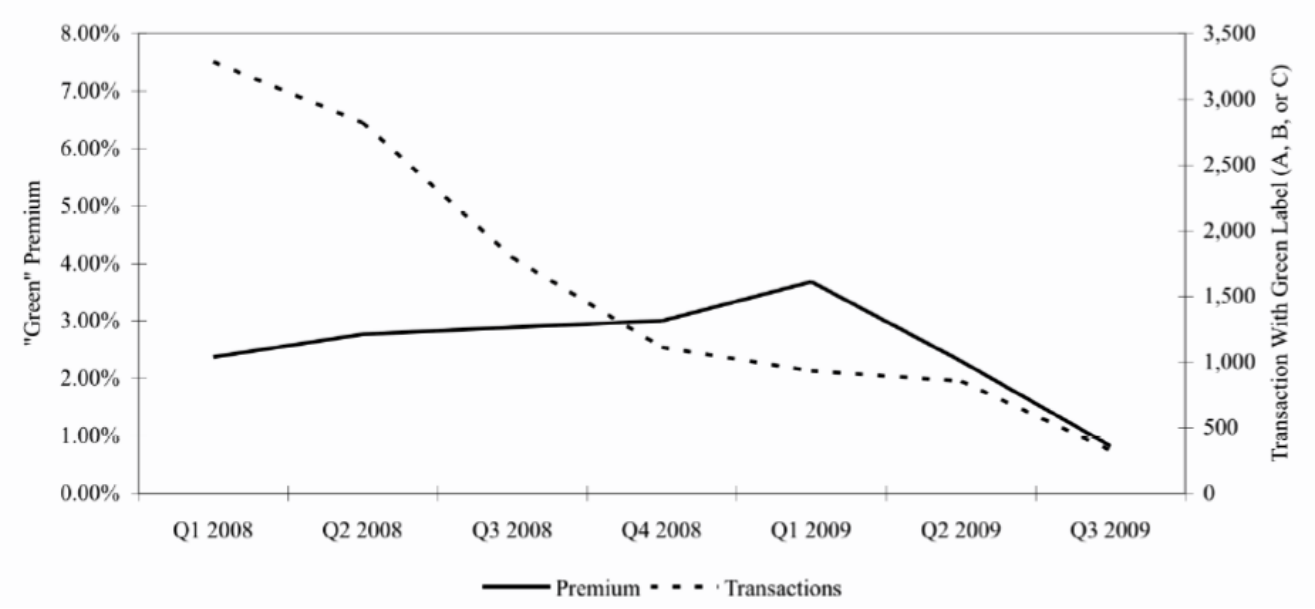

Figure 2: Transaction prices and energy performance certification dynamics of 'green' transactions [25]

5.2 Methodology & Analysis

As part of the Kirklees Warm Zone home assessments, data was gathered in order to calculate a rudimentary SAP energy efficiency rating. If measures, such as hot water tank jackets, cavity wall or loft insulation, were installed a second SAP rating was calculated to ascertain the improvement in energy efficiency of the dwelling.

Using the change in energy rating for dwellings that had measures installed, along with the number of measures they had installed, we have calculated an estimated change in property prices utilising property values from the Land Registry House Price Index.

It is also important to note that it is beyond the scope of this report to judge what insulation would have been installed had the Kirklees Warm Zone project not provided funding; either through another (CERT) scheme or paid for by the property owner directly. The increase in house prices has been calculated in today's terms as it is not possible to predict when properties will change hands.

The average SAP improvement for homes improved in Kirklees was 5.6. From the Land Registry House Price Index the average house price in Kirklees for February 2011 was £117,336[26]. Assuming the relationship found in the Dutch study cited above applies proportionately this equates to an average improvement in house value of 0.67%. The improvement would be £790 per house spread over 48,596 properties where a change in the SAP rating was noted giving a total of £38,377,179.

5.3 Discussion of findings

51,155 homes were treated through the Kirklees Warm Zone scheme at a total cost of over £20 million meaning that on average just over £400 was spent per home on installing insulation measures. When compared to the average increase in property prices of £790 per property, this shows that the investment provided good value for money as the total increase in value of the housing stock after the project was almost twice the initial investment.

[25] Figure 3, p23, On the Economics of Energy Labels in the Housing Market, Brounen, Dirk and Kok, Nils, 2010. Available at SSRN: http://ssrn.com/abstract=1611988

[26] http://www1.landregistry.gov.uk/houseprices/housepriceindex/report/default.asp?step=4&locationType=0&area=Kirklees&reporttype=3&datetype=1&from1=01%2F1995&from2=02%2F2011&image2.x=34&image2.y=8

The lack of in depth research into the link between the SAP rating of a property and its market value makes it very difficult to assess the impact of the Kirklees Warm Zone on property prices in the area. The figure of just over £38 million for the total increase in the value of the housing stock in Kirklees should be regarded as an indication only for the following reasons:

- The analysis is applied to all properties where a change in the SAP rating was noted, however it has not been broken down further to assess the change in value that would occur if a property moved from say an EPC rating of G before treatment to a C after treatment, versus one that moved from a G to an F. There is little evidence to show that the greater the EPC improvement, the greater the increase in house value.
- The £38 million increase in property value will not have any impact on the Kirklees economy until the properties actually change hands. As this could take place at any time, the £38 million represents the total value added to the housing stock over the lifetime of the properties in question.
- Insulating a home can increase the value of a property because in a lot of cases it raises the EPC rating to above average for a house of that particular size and age making it stand out from other similar properties. In the future, levels of insulation in the UK may increase naturally as a result of other government incentives such as the Green Deal. If this is the case then the Kirklees homes will not be significantly different to other homes at the point of sale so the predicted increase in house value may never be realised if the property is not sold until many years into the future.

6 Conclusion

It's clear from the analysis undertaken in this study that assessing the economic impact of a scheme like the Kirklees Warm Zone is a highly complex investigation with many factors that inter relate and many assumptions made where detailed data is not available.

The table below sets out the main findings. From an initial investment of £20.9m of which Kirklees provided 11.7m and Scottish Power the remainder a net social benefit of almost £250m results – a clear indication that this sort of programme is very worthwhile. The majority of these, £156m, come about as a result of savings to householders due to reduced bills. The overall saving to the NHS of £4.8m looks small in proportion to this but is still significant against the initial public sector investment of £11.9m.

	Scheme Costs	Lifetime Fuel Savings (40yrs)	Liftetime CO2 Savings (40yrs)	Jobs Created & Economic Impact	Saving to NHS	House Value Increase	Confirmed Benefit Claims	Net Benefit
Original Measure		4,237 GWh	934 ktonnes	243 FTE		5.6 Avg SAP increase		
Monetised Value	-£20.9m	£156.0m	£30.6m	£39.1m	£4.8m	£38.4m	£0.7m	£248.8m

Table 5: Kirklees Warm Zone Net Social Benefit

The most accurate figures in this analysis are the ones concerning the number of jobs directly created as a result of the Warm Zone as these can be directly accounted for by the project partners. All estimates of indirect and induced jobs and outputs as a result of the investment are subject to errors because assumptions have had to be made about the particular multipliers that should be used, the classification of the initial investment as new or redirected spending and the amount of spending that takes place outside of Kirklees. The estimates of the energy, CO_2 and fuel bill savings are as accurate as they can be without accurate before and after energy consumption figures but even these are subject to assumptions concerning the reduction factors such as comfort takings associated with a reduction in householder energy bills.

The most accurate figures in this analysis are the ones concerning the number of jobs directly created as a result of the Warm Zone as these can be directly accounted for by the project partners. All estimates of indirect and induced jobs and outputs as a result of the investment are subject to errors because assumptions have had to be made about the particular multipliers that should be used, the classification of the initial investment as new or redirected spending and the amount of spending that takes place outside of Kirklees. The estimates of the energy, CO_2 and fuel bill savings are as accurate as they can be without before and after energy monitoring figures but even these are subject to assumptions concerning the reduction factors such as comfort takings associated with a reduction in householder energy bills.

The benefits in terms of the roughly £82m of combined NHS savings, house price value and economic growth probably represent the upper end of the possible values whereas the value of carbon savings and fuel bill savings could easily be higher with more dramatic fuel price rises and revaluations of the economic cost of climate change.

This report has not analysed the efficiencies of the area based approach adopted by Kirklees Warm Zone in detail but according to the scheme contractor, Miller Pattison, – and this is backed up by the highly competitive prices achieved for installation in the Kirklees case – area based schemes can be up to 50% more efficient than the usual scattergun approach. The reason for the greater efficiencies are multiple: greatly reduced travel times, reduced times between jobs, reduced missed calls, greater team efficiency due to constant high work load and ability to purchase materials in higher volumes achieving better pricing.

It should be noted that the figures in this report have not been compared to a counterfactual case (i.e. an analysis of what would have happened in Kirklees anyway if the Warm Zone project had not taken place). Clearly some level of market led insulation activity with and without CERT support would have occurred anyway.

If every local authority in the UK were to implement a similar scheme to the Kirklees Warm Zone, the government would need to significantly increase the CERT (or its successor ECO – Energy Company Obligation) obligations placed on utility companies to ensure that CERT funding is available. Similarly, every created and economic benefits in Kirklees by population, a nationwide Warm Zone project could create up to 37,000 jobs and boost the UK economy by up to £6 billion.

Appendix 1: Supporting Tables

Study			Project costs			Domestic energy saving & thermal comfort		Environmental				Health		Economic	Net social benefit
Source	Year	Location	Discount rate	Currency	Costs	Fuel cost saving	Comfort benefit	CO_2 damage avoidance costs				NHS burden saving		Saving from job created	
Goodacre et al. [27]	2002	English housing stock	0	£ million	16,510	9,853	4,223	566	-	-	-	9,085	-	1,838	9,055
				[28]		Energy	Comfort	CO_2	SO_2	NO_x	PM10	Mortality	Morbidity		
Clinch & Healy [29]	2000	Irish dwelling stock	0	Converted from € million at 0.626	1,294	4,085	456	283	23	11	274	936	69	-	4,843

Table 6: Net social benefits compiled from comparative studies: Units (£ million)

[27] p58 Integrating energy efficiency with the social agenda in sustainability, Christopher Goodacre, Stephen Sharples and Peter Smith, Centre for the Built Environment Sheffield Hallam University, Energy and Buildings 34 (2002) p56-61

[28] xe.com Accessed 29 September 2010. Figure is average from 1 January and 31 December 2000 (the year of the Clinch & Healy study)

[29] p121 Cost-benefit analysis of domestic energy efficiency, J.Peter Clinch, John D. Healy, Department of Environmental Studies, University College Dublin, Energy Policy 29 (2001) p113-124

Employer	Year 1	Year 2	Year 3	Per annum average (FTE)	Average combined salary per annum
Miller Pattison –Operational & delivery staff	85	85	85	85	£1,930,000
Miller Pattison – Training staff	3	3	3	3	£68,100
Yorkshire Energy Services - Office staff	11	11	11	11	£360,000
Yorkshire Energy Services – self-employed assessors	60	60	40	20	£178,340
Kirklees Council – Environment Unit	2.5	2.5	1.5	2.0	£87,000
Citizen's Advice Bureau	2	4	5	3.5	£105,000
ScottishPower[30]	0.5	0.5	0.5	0.5	£15,000
Safelincs[31]	1	1	1	1	£30,000
	165	**167**	**147**	**126**	**£2,668,440**

Table 7 Kirklees Warm Zone employment statistics

	Employment	Income	Output
Input type	Number of jobs	Employee income	Output[32]
Direct	The number of jobs created by the Warm Zone project in Kirklees with the installers and administrators of the scheme as a direct result of the project e.g. at Miller Pattison, Yorkshire Energy Services and other project partners	Additional income paid to employees of project partners like Miller Pattison created by the change in final demand created by the Warm Zone project.	Amount invested into the Warm Zone scheme by all the partners
Indirect	E.g. The number of additional jobs created at the company that manufactures insulation due to the increased demand for insulation by Miller Pattison	E.g. Additional income paid to employees of companies in the supply chain of the Warm Zone project partners created by increased demand through the supply chain	Value of additional sales created through the supply chain or Warm Zone Partners as a result of the investment
Induced	E.g. The number of additional jobs created by the employees holding the newly created direct and indirect positions spending	Additional income to employees in other organisations outside the project created by the additional spending of the direct	Additional spending in the economy as a result of more employees having more income available to spend on final

[30] Average salary of 1 FTE Scottish Power employee assumed to be £30,000 pa in absence of more accurate data

[31] Average salary of 1 FTE Safelincs employee assumed to be £30,000 pa in absence of more accurate data

[32] The value of project can be used to represent change in demand for goods/services i.e. output because if say £5m is invested in a new scheme then the partners involved must increase their output by £5m.

	a proportion of their income from spending on goods and services, as a result of the additional jobs above	and indirect employees that were employed as a direct and indirect result of the Kirklees Warm Zone.	goods & services

Table 8: Summary of multiplier types

	Possible multipliers for Construction Industry group: Scottish Government category 88 or SIC2003 Construction 45 (Plumbing 45:3)			
Type	**Output multiplier**	Income multiplier	**Employment multiplier**	GVA multiplier
I (Direct + indirect impacts)	**1.59**	1.61	**1.58**	1.62
II (Direct + indirect + induced impacts)	**1.88**	1.91	**1.93**	1.95

Table 9: Possible economic multipliers for Construction

Source	Multiplier description	Type I	Multiplier
Scottish Government 2003	National direct & indirect, Construction	Employment GVA Income Output	1.58 1.62 1.61 1.59
Crossrail	A predictive national multiplier based on other studies and Scottish Government figures for construction, with leakage abroad based on a range of multipliers of between 1.33 and 1.86	Employment	1.50
Association for the Conservation of Energy, Employment in Energy Efficiency, Integrating energy efficiency with the social agenda in sustainability	Predictive multiplier for impacts of domestic heating and hot water energy efficiency upgrading schemes in England based on previous studies	Employment	1.17
Modelling the North East Economy: The Impact of Fuel Poverty Intervention on Economic Activity in the North East of England	Retrospective regional multiplier for an energy efficiency scheme from Durham University's economic model	Employment GVA from installations GVA from energy savings	1.48 1.61 1.5
REM	Construction industry national, Experian (no displacement) Construction industry regional, Yorkshire Forward (no displacement) Kirklees Warm Zone (project ongoing)	Employment Employment Employment	1.55 1.61 1.23

Table 10: Comparison of Type I multipliers from various sources for projects similar to Warm Zone

Total Warm Zone project		Output impact			Employment impact		
	Type	Factor	Additional	Cumulative	Factor	Additional	Cumulative
Direct		1.00	£20,854,862	£20,854,862	1.00	126	126
Indirect	I	0.59	£12,309,201	£33,164,063	0.58	73	199
Induced	II	0.29	£5,969,296	£39,133,358	0.35	44	243
Total		**1.88**	**£39,133,358**		**1.93**	**243**	

Table 11: Kirklees Warm Zone direct, indirect and induced output and employment impacts from total project expenditure and direct employment

Kirklees Council contribution only		Output impact			Employment impact		
	Type	Factor	Additional	Cumulative	Factor	Additional	Cumulative
Direct		1.00	£11,726,858	£11,726,858	1.00	126	126
Indirect	I	0.59	£6,921,564	£18,648,422	0.58	73	199
Induced	II	0.29	£3,356,583	£22,005,005	0.35	44	243
Total		**1.88**	**£22,005,005**		**1.93**	**243**	

Table 12: Kirklees Warm Zone direct, indirect and induced output and employment impacts from Kirklees Council project expenditure and direct employment

Impact	Units	Factor	Total impact	Cost of one unit of impact against total Warm Zone project spend	Cost of one unit of impact against Kirklees Council project contribution
Project spend				£20,854,862	£11,726,862
Jobs created				**One FTE job cost**	**One FTE job cost**
Direct	FTE	1.00	126	£165,514	£93,070
Direct + Indirect	FTE	0.58	199	£104,798	£58,928
Direct + Indirect +Induced	FTE	0.35	243	£85,822	£48,258
Total employment	**FTE**	**1.93**	**243**	**£85,822**	**£48,258**

Table 13: Cost per unit of output and employment impacts

Project total		Scottish Government		Multiplier from ACE		Crossrail multiplier	
	Type	Factor	Additional	Factor	Additional	Factor	Additional
Direct		1.00	126	1.00	126	1.00	126
Indirect	I	0.58	73	0.17	21	0.50	63
Total		**1.58**	**199**	**1.17**	**147**	**1.50**	**189**
% diff to SC total figure					**-26%**		**-5.0%**

Table 14: Sensitivity analysis - Kirklees Warm Zone direct and indirect employment impacts

Heating fuel	Saving GJ	CO_2 Saving tpa
Unknown	765	44
Anthracite	182	10
Bottled Gas Cylinders	46	5
Bulk LPG	753	64
Electricity (Not off peak)	3,801	310
House Coal	1,327	118
Mains Gas	736,369	44,481
Off Peak Electricity	10,308	1,020
Oil	3,978	296
Smokeless Fuel	4,056	346
Wood	929	6
Total	**762,514**	**46,700**

Table 15 Maxim annual GJ and CO_2 savings by primary fuel type

Heating type	Calculated emission factor $kgCO_2/kWh$	SAP 2005 emissions factors[33] ($kgCO_2/kWh$)	Difference
Unspecified Heating Fuel	0.207	-	-
Anthracite	0.198	0.318	-37.8%
Bottled Gas Cylinders	0.391	0.245	59.7%
Bulk LPG	0.306	0.245	24.9%
Electricity (Not off peak)	0.294	0.517	-43.2%
House Coal	0.320	0.301	6.3%
Mains Gas	0.217	0.198	9.8%
Off Peak Electricity	0.356	0.517	-31.1%
Oil	0.268	0.274	-2.2%
Smokeless Fuel	0.307	0.347	-11.5%
Wood	0.023	0.028	-17.0%

Table 16: Comparison of CO_2 emission factors (tonnes/kWh) assumed by Maxim (based on 100% primary fuel) with SAP 2009 emissions factors

Domestic fuel payment type	Credit	Direct debit	Prepayment
Gas p/kWh average	3.78	3.51	3.82
Electricity p/kWh average	12.75	11.44	12.98
Gas payment method Yorkshire	30%	54%	16%
Electricity payment method Yorkshire	35%	51%	14%

Table 17: Average domestic fuel prices September 2010 for Leeds[34]

[33] Figures taken from The Government's Standard Assessment Procedure for Energy Rating of Dwellings, 2009 edition, incorporating RdSAP2009. Accessed at http://www.bre.co.uk/filelibrary/SAP/2009/SAP-2009_9-90.pdf

Impact	Units	Annual saving	Lifetime (years)	Lifetime saving	Cost of one unit of impact against total project spend	Cost of one unit of impact against Kirklees Council project contribution
Project spend					£20,854,862	£11,726,858
Environmental						
CO_2 savings	tonnes	23,350	40	934,008	£ 22.33	£ 12.56
Energy saved	MWh	105,913	40	4,236,529	£ 4.92	£ 2.77
Fuel bill reduction	£	£3,900,722	40	£156,028,895	£0.13	£0.08

Table 18: Kirklees Warm Zone summary CO_2, Energy and fuel saving

	p/kWh	£/kWh
Gas Price	3.6406	0.03641
Electricity price	12.1141	0.12114

Table 19: Calculated average Cost of Fuels for Kirklees district

Heating fuel	Saving GJ	Price p/kWh	Total £ saving
Unknown	765	3.60	£7,650.61
Anthracite	182	2.86	£1,446.00
Bottled Gas Cylinders	46	8.34	£1,065.75
Bulk LPG	753	5.73	£11,986.21
Electricity (Not off peak)	3,801	12.11	£127,766.05
House Coal	1,327	2.97	£10,948.63
Mains Gas	736,369	3.64	£7,364,281.90
Off Peak Electricity	10,308	6.17	£176,681.80
Oil	3,978	4.06	£44,866.59
Smokeless Fuel	4,056	3.73	£42,028.03
Wood	929	4.93	£12,723.16
Total	**762,514**		**£7,801,444.73**

Table 20: Maxim calculated fuel saving figures per annum (unadjusted)

Heating fuel	Saving GJ/yr	CO_2 Saving tpa	£/yr Saving
Unknown	383	22	£3,825
Anthracite	91	5	£723
Bottled Gas Cylinders	23	3	£533

[34] www.decc.gov.uk/assets/decc/Statistics/publications/prices/566-qepsep10.pdf

Bulk LPG	377	32	£5,993
Electricity (Not off peak)	1,901	155	£63,883
House Coal	664	59	£5,474
Mains Gas	368,185	22,241	£3,682,141
Off Peak Electricity	5,154	510	£88,341
Oil	1,989	148	£22,433
Smokeless Fuel	2,028	173	£21,014
Wood	465	3	£6,362
Total	**381,257**	**23,350**	**£3,900,722**

Table 21: CERT Correction Factor Adjusted Annual Energy, CO_2 and £ Savings

Assumption		Result	
Discount Rate (%)	3.50	Simple Payback [years]	5.3
Evaluation Period (yrs)	40	NPV at [40 years]	£128,650,976
Fuel price inflation (%)	5	IRR at [40 years]	23.7%

Table 22: Scheme NPV and IRR & Assumptions

	Annual CO_2 tpa	Lifetime CO_2 tpa
Scottish Power	22,679	902,701
Maxim (Correction Factor Adjusted)	23,350	934,008

Table 23: Scottish Power CO_2 Savings Using CERT Methodology compared to Maxim Adjusted Figures

Variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Discount Rate %	3.50	3.5	10	10
Evaluation Period yrs	40	40	40	40
Fuel price inflation %	5	10	5	10
Break-even year]	3	2	3	3
NPV at [40 years]	£128,650,976	£301,341,837	£46,964,638	£94,656,479
IRR at [40 years]	23.7%	28.7%	23.7%	28.7%

Table 24: Sensitivity Analysis for NPV and IRR varying discount rates and fuel price inflation

Study	Total cost (€ million)	Energy savings (€ million pa)	Lifetime of measures (years)	Lifetime Energy saving-cost ratio	Payback period (years)
Kirklees Warm Zone	**21**	**4**	**40**	**7.5**	**5.3**
1. CBA of residential energy conservation in Ireland	2,066	218	30	3.2	7
2. Jobs and energy conservation (USA)	23,617	3,352	10	1.4	< 10
3. Too cold for comfort	94,469	45,751	30	1.5	
4. Employment effects of energy conservation investments in EC countries	22,246	3,047	38	5.2	4 to 5
5. Energy investment for a stronger Louisiana economy (USA)	330	48	20 years	2.9	< 5
6. Impact evaluation of Ohio's weatherization assistance program (USA)	28	3	depends on measures mean = 12 yrs	0.9	
7. Economic and greenhouse gas emission impacts of electric energy efficiency investments (USA)	1,625	317	13	2.6	
8. Major energy savings, environmental and employment benefits by double-glazing (EU)	12,697	13,000	10	1	10

Table 25: Comparable studies summary
from 'Cost-benefit analysis of domestic energy efficiency' report p122 [35]

Studies outlines above:

1. Cost-benefit analysis of domestic energy efficiency, J.Peter Clinch, John D. Healy, Department of Environmental Studies, University College Dublin, Energy Policy 29 (2001) p113-124
2. Environmental Resources Ltd. (1983) Environmental Resources Ltd., 1983. Jobs and energy conservation. Association for the Conservation of Energy, London.
3. Hodgkinson (1986) Hodgkinson, S., 1986. Too Cold for Comfort. Earth Resources Research, London.
4. Fraunhofer Institute (1985) Fraunhofer Institute, 1985. Employment effects of energy conservation investments in EC countries. European Commission DG VII, Brussels.
5. Laitner (1991) Laitner, S., 1991. Energy Investments for a Stronger Louisiana Economy. Economic Research Associates, Oregon.
6. Blasnik (1998) Blasnik, M., 1998. Impact evaluation of Ohio's home weatherization assistance program: 1994 program year. Proctor Engineering Group, Ohio.
7. Arny et al. (1998) Arny, M., Clemmer, S., Olson, S., 1998. The Economic and Greenhouse Gas Emission Impacts of Electric Energy Effciency Investments: Report 4 of the Wisconsin Greenhouse Gas Emission Reduction Cost Study. The Consortium for Integrated Resource Planning/University of Wisconsin/Leonardo Academy Inc. for the US Department of Energy and Oak Ridge National Laboratory, Wisconsin.
8. Thermie (1995) Thermie, 1995. Major energy savings, environmental and employment benefits by double-glazing and advanced double-glazing technologies. Thermie for European Commission DG XVII, Brussels.

[35] Cost-benefit analysis of domestic energy efficiency, J.Peter Clinch, John D. Healy, Department of Environmental Studies, University College Dublin, Energy Policy 29 (2001) p113-124

	Number of households	Health problem	Stroke thrombosis	Heart problem	Respiratory problem	Mobility problem	Major surgery in last 3 months	Long term condition
Total reported	133,714	38,466	12,219	9,126	15,535	19,242	2,149	14,260

Table 26: Kirklees Warm Zone health statistics

Appendix 2: Overview of Kirklees Warm Zone

Kirklees in West Yorkshire is the third largest metropolitan district in the UK including the towns of Huddersfield and Dewsbury with approximately 401,000 residents living in 172,000 households.

KC has a long history of addressing CO_2 emissions with 'Reducing Carbon' a key strand of the council's 'Four Part Ambition' strategy. Aware of the potential efficiencies of an area-wide approach, between 2007 and 2010 KC undertook the largest and most comprehensive local authority energy efficiency schemes to date in the UK. KC set up a Warm Zone with the aims of tackling fuel poverty, delivering a low carbon Kirklees, improving the uptake of state benefit support by residents and creating jobs.

Energy efficiency measures such as loft and cavity wall insulation, low energy light bulbs and carbon monoxide detectors were offered to all suitable properties free of charge with no means testing of those able to pay. Assessors also offered benefit advice and referred residents to other providers for services such as water conservation advice and fire safety checks. Improvements to heating systems were available to eligible households and competitive prices for boilers and central heating were also offered for customers who are able to pay.

Door-to-door home energy checks to assess insulation status of all households were undertaken through a staged process tackling one ward at a time. This area-wide approach increased productivity by 50%, by saving on assessor and installer travel time, as well as reduced costs with the average cost per measure at approximately £224.

The project cost £20 million over the three years, with £9 million of CERT funding from ScottishPower and £11 million from Kirklees Council's Capital Plan.

The project partners included:

- Personnel in Kirklees Council's Environment Unit
- Yorkshire Energy Services (the local energy efficiency advice centre) - the managing agent, previously known as Kirklees Energy Services
- Scottish Power - co-funder with the council of the capital insulation measures.
- National Grid British Gas Transco Accountant from was seconded as Finance Manager
- Miller Pattison - insulation contractor
- Four benefits agencies:
    - Kirklees Citizens' Advice Bureau (CAB)
    - Pensions Service
    - Kirklees Benefits Advice Service (Kirklees Council)
    - Revenue and Benefits (Kirklees Council)
- Warm Zone Ltd – the Director and Deputy Director sit on the Warm Zone board
- Additional referrals support:
    - West Yorkshire Fire Service provides fire safety checks and smoke alarms.
    - Yorkshire Water provides water conservation advice.
    - Carers Gateway (Kirklees Council) offer support to people who care for friends or family.
    - Safelincs are the contractor appointed to supply the carbon monoxide detectors
    - Energy Saving Trust advice packs
    - Private Sector Housing (Kirklees Council) facilitating home appreciation loans for non-decent private homes

- Kirklees Neighbourhood Housing – referrals for council housing stock requiring insulation measures.

Over its 40 month duration, the Kirklees Warm Zone has achieved the following:

- All households in Kirklees has been visited
- 133,755 doorstep energy assessments have been carried out
- 42,999 properties have had loft insulation installed
- 21,473 have had cavity wall insulation installed
- As a direct result of the advice delivered to them by Warm Zone Assessors, 868 households are now claiming additional benefits that they are eligible for having been previously unaware that support was available. For each of these households, the average gain is £2,552 per annum
- Over 550 households have had central heating installed through local or regional funding
- 446,860 low energy light bulbs have been distributed
- 26,455 homes have been referred to the fire service for a fire safety check, resulting in 9,896 smoke alarms being fitted to date.
- 130,664 Carbon Monoxide Monitors have been provided
- Over 126 full time equivalent (FTE) positions have been directly created over the three year duration of the project across all the project partners

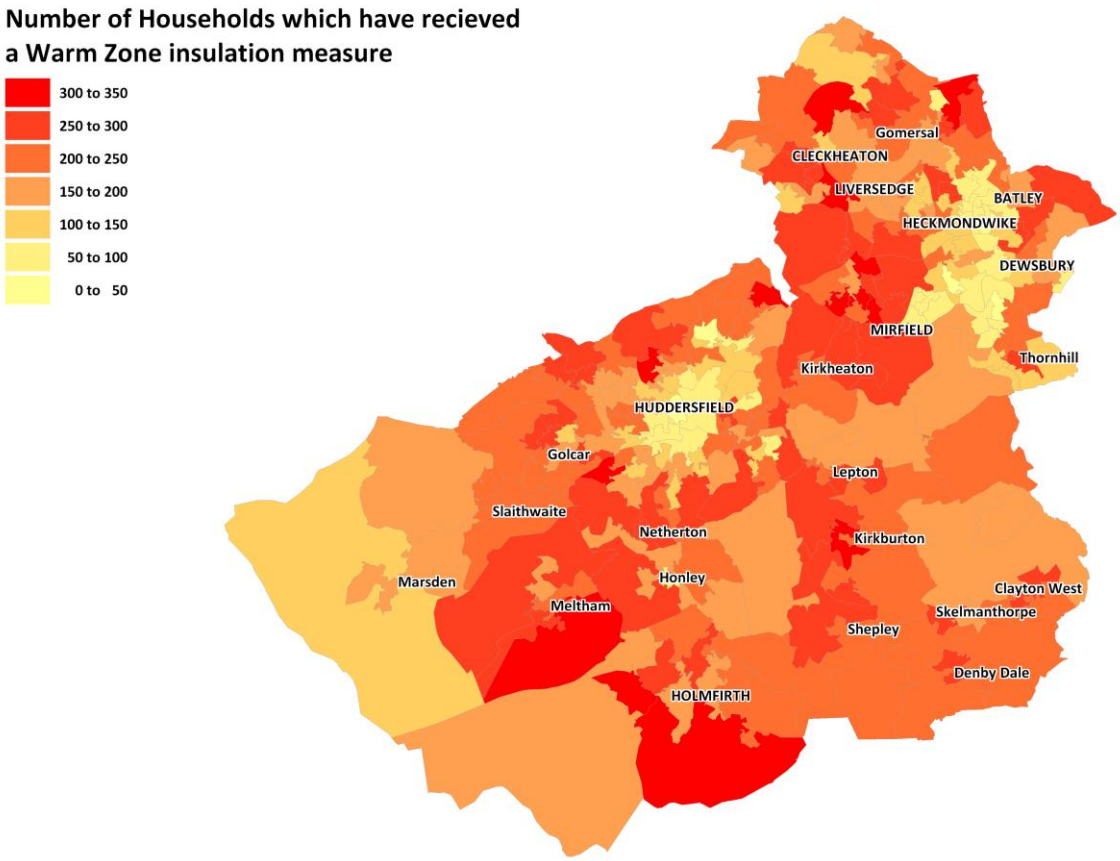

Figure 3: Number of households treated by super output area

Appendix 3: Further Information on economic multipliers

Multipliers applied: Some examples

North East fuel poverty schemes

Analysis of the impact of several anti-fuel poverty initiatives upon the North East region of England calculated the number of jobs created by Warm Front, Warm Zones and The Energy Efficiency Commitment (EEC) in the 2005/06 financial year. NB we have calculated the associated employment multiplier from the study's figures in the table below.

Source	Direct FTE	Additional FTE effect elsewhere in the economy	As multiplier	Total regional employment generated
As a result of household savings resulting from reduced energy consumption	86	21	1.24	107
From installation of measures	163	99	1.61	262
Total	**249**	**120**	**1.48**	**369**

Table 27: Employment generated from fuel poverty interventions in the North East compiled from 'Modelling the North East Economy' 2008 [36]

Additionally, the same study calculated the economic impact as Gross Value Added (GVA) of installations per £ of project spend and economic impact (GVA) accruing to households per £ of cost saved from energy savings. The report defines GVA as "*the difference between the value of goods and services that have been produced and the cost of raw materials and other non-labour inputs which are used up in their production*". We have converted these figures into GVA multipliers in Table 28 for comparison.

EU Energy efficiency programmes

A comprehensive analysis of the national and local economic impacts of 44 energy efficiency programmes from 9 EU countries included thee UK residential schemes, termed fiscal i.e. they provided measures to residents. The report found that *"in the majority of cases, energy efficiency investment programmes increased employment"*[37] and that projects that invested in the residential sector resulted in a *"net increase in total employment over a 15 year period, ranging from 9 to 14 person-years per MEuro invested."*[38]

Energy efficiency in the England housing stock

A study to predict the impacts domestic heating and hot water energy efficiency upgrading schemes in England could have, utilised a Type I employment multiplier of 1.17 (for direct and indirect jobs), sourced from pervious work by the Association for the Conservation of Energy [39].

[36] Modelling the North East Economy: The Impact of Fuel Poverty Intervention on Economic Activity in the North East of England, Andrew Hunt Durham University and David Lynch and Neil Ritchie National Energy Action January 2008

[37] 'National and Local Employment Impacts of Energy Efficiency Investment Programmes', Final report to the Commission SAVE contract XVII/4.1031/D/97-032. April 2000 Dr Joanne Wade, Victoria Wiltshire, and Ivan Scrase, p5

[38] 'National and Local Employment Impacts of Energy Efficiency Investment Programmes', Final report to the Commission SAVE contract XVII/4.1031/D/97-032. April 2000 Dr Joanne Wade, Victoria Wiltshire, and Ivan Scrase, p7

[39] Association for the Conservation of Energy, Employment in Energy Efficiency, Briefing Notes 97/5, 1997 from p58 Integrating energy efficiency with the social agenda in sustainability, Christopher Goodacre, Stephen Sharples and Peter Smith, Centre for the Built Environment Sheffield Hallam University, Energy and Buildings 34 (2002) p56-61

Source	Project statistic	Direct (within NE region)	Additional (elsewhere in the region)	Total regional impact
Economic impact of the **installations** (of WarmFront and EEC measures)	Project spend £13,718,000			
• GVA		£5,045,000	£3,365,000	£8,410,000
• GVA multiplier (from GVA per £1 project spend)		1.37	1.25	1.61
Economic impact accruing to households from their ability to achieve **energy cost savings***	Total energy cost savings £5,643,000			
• GVA		£2,090,000	£759,000	£2,849,000
• GVA multiplier (from GVA per £1 energy cost savings)		1.37	1.13	1.50
Total economic impact supported by the combined effect of the 2005/06 installation expenditures and household energy savings of the Warm front and EEC measures	Installation + economic GVA	**£7,135,000**	**£4,124,000**	**£11,260,000**

Table 28: Economic impact from fuel poverty interventions in the North East compiled from 'Modelling the North East Economy' 2008 [40]

*Not all of this represents additional value to the region's economy. This is because some pre-existing money is being moved from one area of household spending (former energy/fuel spending) to another (such as retail).

Employment estimates from domestic energy-conversation schemes in EC and US

A study of energy-efficiency technologies and heating upgrades to the Irish dwelling stock provided analysis of a range of programmes in the EC and US. Based on their figures we have included the full time equivalent jobs created here based on their stated duration of 10 years*.

Study	Gross cost (1997 € million)	Job-years	Gross cost/ job-year (1997) (€)	*FTE
1. Jobs and energy conservation	23,617	500,000	47,234	50,000
1. Jobs and energy conservation	57,900	1,223,000	47,342	122,300
2. Too Cold for Comfort	94,469	2,500,000	37,787	250,000
3. Employment effects of energy conservation investments in EC	22,246	594,000	37,450	59,400
4. Energy Investments for a Stronger Louisiana Economy	335	12,600	26,603	1,260

[40] Modelling the North East Economy: The Impact of Fuel Poverty Intervention on Economic Activity in the North East of England, Andrew Hunt Durham University and David Lynch and Neil Ritchie National Energy Action January 2008

5. Fuel Poverty: From Cold Homes to Affordable Warm	25,141	970,000	25,917	97,000
6. Direct and indirect job creation from the standards of performance for energy efficiency programme	23	394	57,138	39
Mean	**31,962**	**828,571**	**39,924**	
7. Cost-benefit analysis of Irish domestic energy efficiency	3,035	49,000	51,627	4,900

Table 29: Employment estimates from energy-conservation studies from 'Cost-benefit analysis of domestic energy efficiency' report p115 [41]

1. Environmental Resources Ltd. (1983) Environmental Resources Ltd., 1983. Jobs and energy conservation. Association for the Conservation of Energy, London.
2. Hodgkinson (1986) Hodgkinson, S., 1986. Too Cold for Comfort. Earth Resources Research, London.
3. Fraunhofer Institute (1985) Fraunhofer Institute, 1985. Employment effects of energy conservation investments in EC countries. European Commission DG VII, Brussels.
4. Laitner (1991) Laitner, S., 1991. Energy Investments for a Stronger Louisiana Economy. Economic Research Associates, Oregon.
5. Boardman (1991) Boardman, B., 1991. Fuel Poverty: From Cold Homes to Affordable Warmth. Belhaven Press, London.
6. Association for the Conservation of Energy (1997) Association for the Conservation for Energy, 1997. Direct and indirect job creation from the standards of performance for energy efficiency programme. Energy Saving Trust and UNISON, London.
7. J.Peter Clinch, John D. Healy Cost-benefit analysis of domestic energy efficiency, J.Peter Clinch, John D. Healy, Department of Environmental Studies, University College Dublin, Energy Policy 29 (2001) p113-124

[41] Cost-benefit analysis of domestic energy efficiency, J.Peter Clinch, John D. Healy, Department of Environmental Studies, University College Dublin, Energy Policy 29 (2001) p113-124

Appendix 4: Comfort taking and reduction factors

In this study we have applied reduction factors to the energy savings that should be achieved by installing insulation in homes to take into account 'comfort takings', i.e. the increase in energy use that often accompanies the installation of insulation due to people being able to afford to keep their homes warmer. The Ofgem CERT methodology and the Warm Front methodology are outlined below.

Ofgem's CERT methodology:

"A further adjustment is then made to take account of factors not considered in this BREDEM calculation. A recent study has shown that the net savings of loft and cavity wall insulation achieved in practice is likely to be 50% lower than that calculated using BREDEM. This includes a 'comfort factor', a reduction due to part of the saving being taken in improved comfort (i.e. increased internal temperatures), which has been found to be of the order of 15% for all insulation measures. The rest of the factor is thought to be due to areas of wall that cannot, or tend not to be, filled with insulation in practice (e.g. lintels, tiled areas of wall, areas above conservatories, areas of solid wall), as well as any underperformance of insulated areas of wall (for example due to imperfect fill). The detailed reasons for the considerably lower savings achieved in practice are still under investigation, but the overall reduction has been demonstrated and is therefore taken account of."

Carbon Emissions Reduction Target (CERT) 2008-20011 Technical Guidance Manual

WarmFront

"*CO_2 savings for all measures have been adjusted by both a comfort factor (a reduction to account for part of the theoretical saving being taken in improved householder comfort) and, in the case of the insulation measures, by an underperformance factor (which account for further reductions due to other factors, such as areas of cavity walls not being filled successfully etc.). There is evidence that a high level of comfort is taken from Warm Front installations, therefore, the comfort factor has been set at 40% for the calculation of savings from all measures (insulation and heating). This has been combined with an underperformance factor of 41% for insulation measures, giving a total reduction factor of approximately 65% for insulation."*

Carbon dioxide emissions savings from the Warm Front programme, December 2008

The two table below shows data from Kirklees Maxim database of annual energy savings in gigajoules by house age and primary heating fuel achieved through the Kirklees Warm Zone (as of October 2010). It can be seen that the vast majority of the energy savings occur where a property is heated primarily by mains gas as this is the predominant heating fuel. Unsurprisingly the majority of savings are also delivered in properties built prior to 1981. As Building Regulations improved progressively through 70s, 80s and 90s so the scope for loft and cavity retrofit measures decreased.

		Building age: Date built													
Heating type	Total energy saving	unspecified	Before 1900	1900 - 1929	1930 - 1949	1950 - 1965	1966 - 1974	1975 - 1981	1981-1990	1982 - 1990	1991 - 1995	1996 - 1997	1996 - 2002	1998 - 2002	After 2002
Unspecified Heating Fuel	765	89	124	121	125	274	32			0	0		0	0	0
Anthracite	182		6	13	68	48	37			10					
Bottled Gas Cylinders	46		2	2	23	19									
Bulk LPG	753		436	119	18	48	50	26		18	12		6		0
Electricity (Not off peak)	3,801		854	618	560	448	922	263		44	31	0	24		37
House Coal	1,327		737	273	101	123	69	17		4			2		1
Mains Gas	736,369	17	114,243	95,700	129,235	146,215	160,426	45,436	94	22,543	9,556	5	11,026	433	931
Off Peak Electricity	10,308	2	2,589	1,079	1,722	2,356	1,707	413		215	158		58		5
Oil	3,978		2,706	398	123	514	114	47		49	10		16		1
Smokeless Fuel	4,056		1,570	518	797	735	301	110		25	0		0		0
Wood	929		644	69	50	44	107	0		15			0		0
Total	762,514		123,911	98,910	132,822	150,824	163,765	46,312	94	22,923	9,767	5	11,132	433	975

Table 30: Kirklees Warm Zone energy saving in gigajoules per year by fuel type and building age

Heating type	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980	don't know

Unspecified Heating Fuel						
Anthracite						
Bottled Gas Cylinders						
Bulk LPG						
Electricity (Not off peak)				20		
House Coal	0					0
Mains Gas						
Off Peak Electricity	4	0	62	95	8	340
Oil						4
Smokeless Fuel						
Wood						
Total						0
	4	**0**	**62**	**115**	**8**	**344**

Table 31: Kirklees Warm Zone energy saving in gigajoules per year by fuel type and building age – continued

The tow tables below shows a similar extract but of annual carbon savings in tonnes by house age and primary heating fuel achieved through the Kirklees Warm Zone (as of October 2010). Again it can be seen that the vast majority of the carbon savings occur where a property is heated primarily by mains gas.

		Building age: Date built

Heating type	Total CO_2 Saving	<>	Before 1900	1900 - 1929	1930 - 1949	1950 - 1965	1966 - 1974	1975 - 1981	1981-1990	1982 - 1990	1991 - 1995	1996 - 1997	1996 - 2002	1998 - 2002	After 2002	don't know
Unspecified Heating Fuel	44	6	8	7	7	14	2			0	0		0	0	0	
Anthracite	10		0	1	4	3	2			0						
Bottled Gas Cylinders	5		1	0	1	3										
Bulk LPG	64		34	15	0	5	4	2		1	1		0		0	0
Electricity (Not off peak)	310		55	51	39	40	90	24		3	1	0	3		4	
House Coal	118		67	23	8	11	6	2		1			0		0	17
Mains Gas	44,481	0	6,740	5,684	7,905	8,791	9,812	2,794	6	1,411	563	1	658	27	61	1
Off Peak Electricity	1,020	0	235	76	162	245	215	44		22	17		3		0	
Oil	296		193	31	11	41	8	5		6	0		1		0	
Smokeless Fuel	346		133	47	67	65	22	10		2	0		0		0	0
Wood	6		3	0	0	1	2	0		0			0		0	18
Total	46,700		7,469	5,935	8,204	9,219	10,163	2,881	6	1,446	582	1	665	27	65	

Table 32: Kirklees Warm Zone CO_2 saving in tonnes per year, by fuel type and building age

Heating type	1900-1918	1919-1944	1945-1964	1965-1974	1975-1980
Unspecified Heating Fuel					

Anthracite					
Bottled Gas Cylinders					
Bulk LPG				2	
Electricity (Not off peak)	0				
House Coal					
Mains Gas	0	0	7	4	0
Off Peak Electricity					
Oil					
Smokeless Fuel					
Wood					
Total	**0**	**0**	**7**	**6**	**0**

Table 33: Kirklees Warm Zone CO_2 saving in tonnes per year, by fuel type and building age

- continued

6.1.1 Checking CO_2 Emission Factors

The CO_2 emissions factors that have been applied to the energy savings by Maxim to calculate the carbon savings have been calculated and compared to the emissions factors used by SAP 2009. The Maxim emissions factors have been calculated by dividing the total primary energy saving, (converted to kWh), by carbon emissions savings. In several cases the Maxim emissions factors appear to be significantly different to the SAP 2009 ones, for example:

- The factor for bottled gas appears to be furthest from the SAP 2009 factor with the Maxim figure being almost 60% higher. As bottled gas has only been used as a primary heating fuel in 3 homes it's likely that this could have been caused by a rounding error.
- The factors for electricity are also significantly different with Maxim using a figure of 0.294 $kgCO_2$/kWh compared to 0.517 $kgCO_2$/kWh used in SAP 2009.
- The mains gas emissions factor used by Maxim of 0.217 $kgCO_2$/kWh is 9.8% higher than the SAP 2009 figure of 0.198 $kgCO_2$/kWh

A further breakdown of the emissions factors from Maxim and how they compare to SAP 2009 is given in Table 16 in Appendix 1.

The data collected by Warm Zone is based on an Energy Saving Trust standard form which does not give all the information required for a full SAP calculation. Maxim 2009, therefore uses a simplified SAP calculation based on the available data which is known as 'Quick SAP' so there is likely to be some inaccuracy in the figures calculated.

The impact of the difference in emissions factor for bottled gas on the total emissions saved by the project is negligible because it is only applicable to 3 homes. However the difference in the electricity emissions factor is more significant, resulting in around a 3% under estimate of the carbon savings achieved by the Warm Zone. It is unclear why the factors for electricity are significantly different to the SAP 2009 figures. The difference in emissions factors for mains gas could be explained by the assumption under SAP that 10% of heating requirements are supplied by a secondary fuel for which the default is electricity.