

APPENDIX A



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Research in Public Health

Evaluation of the Stockton on Tees ECO scheme (AF154)

Report



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1. Introduction

Fuel poverty is officially defined in England as a situation where a household's income falls below the official poverty threshold (60% of median national household income), after having fuel bills of above the national median level, based on household composition and size¹. The causes of fuel poverty include low household income, household thermal inefficiency and high energy prices². Fuel poverty has been associated with increased rates of excess winter mortality and increased morbidity⁸. Additional adverse outcomes that have been associated with exposure to cold housing and fuel poverty include social exclusion, reduced emotional wellbeing, adverse nutritional outcomes, impaired child development, worse educational attainment and increased healthcare utilisation³. As fuel poverty is by definition concentrated amongst the poorer and most disadvantaged groups then it can therefore contribute to health inequalities between population groups.

The Energy Company Obligation (ECO) was introduced in 2013 and sets out an obligation for large energy suppliers to deliver energy efficiency measures to domestic energy users. This is intended to focus on low income and vulnerable households and hard-to-treat homes⁴.

External wall insulation is a method for improving the thermal efficiency of homes that are unsuitable for cavity wall insulation, either because they are solid-walled (without a cavity), or because their wall cavities are too narrow to insulate. Almost 50% of fuel poor households live in solid wall properties, most of which are un-insulated⁵. Insulating solid bricked housing could reduce fuel poverty and the associated adverse health and social outcomes. In addition to the impact on health and social outcomes a further 3 key benefits of solid wall insulation have been advanced: 1) job creation; 2) revenue stream for the government; 3) wider community benefits⁶.

2. Aims

The aims of this research project are to assess the health and economic benefits of an ECO-funded programme in which external wall insulation was provided to households spread across eight of the most deprived Lower Layer Super Output Areas (LSOAs) in Stockton-On-Tees and areas exhibiting the highest incidences of fuel poverty.

The three research questions for this project are:

1. Has the ECO-scheme made a significant difference to fuel poverty among participating residents?

2. Has the ECO-scheme made a significant difference to health, health care usage and wellbeing among participating residents?
3. Does the ECO scheme provide a significant positive ROI to Stockton council and is it cost-effective)?

3. Study design and methodology

3.1. Study groups

External wall insulation was delivered to a total of 3,265 households spread across eight of the most deprived LSOAs in Stockton-On-Tees and areas exhibiting the highest incidences of fuel poverty. Among these, 2,252 households were selected to participate in this study: 1,149 households that received EWI in 2012 and 1,103 households that received EWI in 2014-2015. The study has also included an additional 1,004 households with similar socioeconomic and housing characteristics to the intervention group participants to represent the non-exposed population from the same LSOAs.

The primary source of data for this project comes from a cross-sectional postal survey with questions about healthcare usage, general health (using the EQ-5D_3L™ health instrument⁹), demographic information including items about household income and fuel consumption. A sample questionnaire is available in Appendix 1.

In total, the questionnaire was posted to 3,256 households, including households from each of three study groups. The study groups are:

- 1) Early cladders - 1,149 households that received the intervention in autumn 2012 as part of the first cohort;
- 2) Late cladders - 1,103 households that have recently received the intervention, as part of the final cohort of this phase of the scheme; and
- 3) Control group - a non-exposed group, consisting of 1,004 households, whose home would otherwise have been eligible for external wall insulation.

3.2. Methods

This project employed quantitative data techniques to address the research questions. The survey company supplied the data as a Microsoft Excel™ spreadsheet convenient for the analysis.

The prevalence of fuel poverty and measures of health and wellbeing from the postal survey between the external (non-exposed) control group and all participants from the two intervention

groups (early and late cladders) were compared. The two separate intervention groups (early and late cladders) were also compared with each other in order to assess if there was a greater effect amongst those whose households were clad earlier, as they might have had longer time to benefit from the intervention.

The data from the cross-sectional analysis were prepared in Microsoft Excel™ format and analysed using Stata™ statistical software package. The mean, median and interquartile range are used to measure changes in EQ-5D-3L data, use of health services and fuel poverty between the groups. Where data is normally distributed, the significance of this change is tested using the t-test, and non-parametric independent-samples Mann-Whitney U test is applied on non-normally distributed data.

Further, a statistical regression was used to control for certain variables and compare the means to allow fairer comparison between the study groups.

In addition, a Return on Investment (ROI) model was conducted on this project, to evaluate the amount of return on an investment relative to the investment's cost (see Section “Outline of the ROI analysis below” below).

3.3. Outline of the ROI analysis

The ROI model is used to estimate the reduction in healthcare and fuel costs based on the aggregate changes in use of fuel and NHS resources by study participants. The ROI is calculated using the following formula:

$$\text{ROI (\%)} = (\text{Benefits} - \text{Investment Costs}) / \text{Investment Costs}$$

The ROI Calculator v4r⁷ estimates the ROI of a quality improvement initiative using the financial benefits and costs data from the project:

- 1) Benefits in their monetary value are listed and the potential or actual financial value of those benefits is calculated.
- 2) Cost - project costs including both start-up and any ongoing costs are entered.
- 3) Dividend - a summary table showing the potential or actual return on the investment that has been made.

The ROI analysis included early cladders and control group only as it is assumed that early cladders should have received maximum possible benefit from intervention and this might not be that prominent in the group of late cladders.

3.3.1. Intervention costs

Intervention costs were collected and analysed from the perspective of the stakeholders – Stockton-on-Tees Council. The service costs of delivering the intervention were assessed by collecting the data on the costs of implementing the project and ongoing maintenance, as well as data on staff salaries from the participating local authority – Stockton-on-Tees Council. The data on salaries were calculated as applied to the actual time spent on the project by each member of staff. This data is used to calculate an average cost of delivering the intervention per household.

3.3.2. Benefits of intervention

As a result of the intervention, we explore the possibility of significant changes in the intervention group in terms of their healthcare usage, gas and electricity spending, number of days with comfortable temperature, etc. The monetary value of these changes are calculated and summarised in order to identify a total number of financial benefits gained as a result of the project implementation.

Healthcare usage data used is self-reported and the unit costs of healthcare services are taken from routine sources including, the ‘Unit costs of Health and Social Care’ 2015¹¹ and National Schedules NHS Reference costs 2014-2015¹². Some of the most common standard costs for health care used in this analysis are reported in Table 1.

Table 1. Standard costs for health care.

Unit	Cost	Source
Outpatient GP appointment lasting 11.7 minutes	£39	Unit costs of Health and Social Care 2015
GP telephone conversation lasting 7.1 minutes	£24	Unit costs of Health and Social Care 2015
Practice nurse visit lasting 1 hour	£42	Unit costs of Health and Social Care 2015
Specialist district nurse appointment	£36	Unit costs of Health and Social Care 2015
Outpatient hospital clinic appointment (general medicine, both non-consultant and consultant-led)	£158	Unit costs of Health and Social Care 2015
Night spent in the hospital (national average unit cost per elective inpatient excess bed day)	£359	NHS Reference costs 2014-2015
Dentist	£71	Unit costs of Health and Social Care 2015
GP home visit	£120	Unit costs of Health and Social Care 2015

Mental health nurse visit lasting 1 hour	£37	Unit costs of Health and Social Care 2015
Haematology clinical appointment	£213	NHS Reference costs 2014-2015
Counsellor appointment	£49	Unit costs of Health and Social Care 2015
Midwife visit lasting 1 hour	£68	Unit costs of Health and Social Care 2015
Hospital dermatologist appointment	£111	NHS Reference costs 2014-2015
Physiotherapist appointment	£34	Unit costs of Health and Social Care 2015
Gynaecologist appointment	£155	NHS Reference costs 2014-2015

The costs of medication are taken from the British National Formulary (BNF 2016)¹³. As no data on the dose and/or length of prescription is collected from study groups, it is assumed that a pack of average dose of each medicine was taken by a participant. Where dose of medication is stated by participant, that particular dose is used for analysis.

3.3.3. Dividend

Using the financial costs and benefits data from the project, a ROI of a quality improvement initiative is calculated by subtracting the total cost from the benefit and dividing it by the total cost of project implementation. Discount factor/time adjustment is not applied as the ROI is calculated for the past 4 years rather than adjusting future cash flows. The result is then multiplied by 100 to express the ROI as a percentage.

3.4. Health-related quality of life

The EQ-5D-3L is a tool used to measure health related quality of life and is completed by participants in all groups. The EQ-5D-3L measure divides health status into 5 dimensions (mobility, self-care, usual activities, pain/discomfort and anxiety/depression). Each of these dimensions have 3 levels, hence 243 possible health states exist. The time trade-off approach (TTO) where quality of life is traded against length of life was used to quantify the health state. The health state score produced ranges from 1 (full health) through 0 (death) to -0.594 (worse than death) for the United Kingdom.

Additionally, respondents were asked to indicate on a Visual Analogue Scale (VAS) of 0-100 how good or bad their health was on the day of survey, with 0 being the worst and 100 indicating the best imaginable health state.

Responses of the EQ-5D-3L questionnaire are transformed using a standard algorithm to produce a health state score at the time of survey for each patient. From this, the average health state score and VAS index for each group are calculated. The differences in health state scores between the groups are then monetarised by multiplying them by 4 (the number of years we cost impacts are considered for early cladders) and then by £20,000 – the maximum value that NICE is willing to pay for a quality adjusted life year¹⁴.

4. Results

In total 232 responses have been received with 91 respondents from group 1 (early cladders), 78 respondents from group 2 (late cladders) and 63 completed questionnaires returned from group 3 (control group) participants.

The mean, median and interquartile range are used to investigate changes in EQ-5D data, use of health services and fuel poverty between the groups. Comparative results between the groups are demonstrated as differences with 95% confidence intervals. Statistically, when a confidence interval does not include 0 – no difference between groups, then this provides moderate evidence that a difference is real. Considering the nature of the study and the amount of data available this is probably the strongest finding on quantitative differences between groups possible.

4.1. Study group characteristics

Study groups are not similar in terms of the age and education: control group is the youngest among all with 44% of respondents younger than the age of 45 (this number is 20% for early cladders and 22% for late cladders); they are also the most educated group with 27% obtaining Masters/PhD degree, which is only 15% for early cladders and 16% for late cladders (Table 5).

The groups are different from each other in terms of employment and annual household income, with 39% full time employment in the control group (27% and 21% respectively among early cladders and late cladders); 20% unemployment in the early cladders group (12% in the late cladders and 10% in the control group) and 38% retirement levels in the late cladders group with 26% in the early cladders and 22% retirement in the control group. Interestingly, early cladders have the highest average annual income (£18,687) compared to control group (£16,195) and late cladders (£11,383). Annual household income was calculated on the basis of monthly and weekly (where monthly income is not available) income reported by participants (Table 4).

Due to the natural variances between the groups, these demographical factors were used as effect modifiers when looking at differences between the study groups. Statistical regression was performed and age, income and gender were the variables controlled for during the analysis.

4.2. Health care usage

Health care usage during the last six months was compared between the study groups. No statistically significant differences were observed between the groups, although early cladders had the lowest number of practice nurse appointments and the lowest number of outpatient hospital clinic appointments between all study groups. Late cladders reported less GP home visits and less GP

telephone conversations than any other group. Control group reported slightly less nights spent in the hospital than both intervention groups (Table 2).

4.3. Fuel usage

Fuel usage in the past month also revealed no evidence of a statistically significant difference between the study groups (Table 3). However, the control group reported more money spent on average on both electricity and gas (£153) compared to early (£133) and late cladders (£127). The closest to statistically significant difference in this study (p value = 0.074) is observed between the early cladders and control group (a p value of between 0.05 and 0.1 can be interpreted as weak evidence of a difference).

The same tendency appears when comparing the monetary amount spent on gas (£92 spent by control group against £75 and £74 spent by intervention groups) and electricity (£76 against £52 and £59) separately. The number of days when participants were unable to heat the house to a comfortable temperature were similar across all three groups (2.8, 2.6 and 2.6 days respectively for early cladders, late cladders and those whose houses were not clad).

4.4. General health on the day of survey

There was no evidence of any statistically significant differences between the study groups with late cladders and control groups showing almost identical results. Both of these groups show slightly better health reported by both TTO score and VAS (perceived health state) than those whose houses were clad early. However, after controlling for variables such as age, gender and annual income, early cladders showed better health than the control group based on the EQ-5D TTO score (Table 4).

4.5. Return on investment

4.5.1. Intervention costs

The service costs of delivering the intervention were assessed by collecting the data on the costs of implementing the project and ongoing maintenance, as well as data on staff salaries from the participating local authority - Stockton Council. This data was used to calculate an average cost of delivering the intervention per household (£4,539.50) and a total cost of delivering the intervention to 3,256 households (£14,780,612) (Table 7).

4.5.2. Ongoing benefits: fuel spending

As a result of the intervention, we explored the possibility of significant changes in the intervention group in terms of their gas and electricity spending (Table 8a). After controlling for demographical

differences between the study groups, it is estimated that an average household from the early cladders' intervention group spends £40 less on fuel per month (£480 less per year) than a household from the control group. Collectively, 3,256 insulated households could spend £1,562,880 less on gas and electricity per year than 3,256 houses without insulation. For the period of four years this could mean £6,251,520 spent less on house heating compared to 3,256 non-insulated households from the same LSOA.

4.5.3. Ongoing benefits: health-related quality of life

The adjusted difference in health-related quality of life between the early cladders and control group (0.01) has been monetarised by assuming that the differences persist for at least four years of cladding and multiplying them by £20,000 – the maximum value that NICE will pay for a quality adjusted life year¹⁴. It is estimated that the difference between the intervention (early cladders) and control group in terms of health-related quality of life is £200 per year per person. This number equals to £651,200 per year for a total of 3,256 insulated households and results in £2,604,800 for the period of four years.

4.5.4. Ongoing benefits: healthcare usage

In terms of healthcare usage, it is calculated that for an average subject from the intervention group (early cladders) NHS spends £1,572 per year, compared to £1,363 for a subject from the non-exposed control group – i.e. £209 more per person from the early cladders group (Table 8b). Collectively, 3,265 subjects from insulated households require £695,035 more spending of NHS resources per year than 3,265 subjects from houses without insulation. For the period of four years this goes up to £2,780,140 more spending of NHS resources for the cohort of insulated houses.

4.5.5. Dividend

Benefits from reduced fuel consumption were summarised with the monetary value of differences in healthcare usage between the study groups in order to identify a total number of financial benefits gained as a result of the project implementation (Table 9). These numbers were multiplied by four – as per four years since intervention in the early cladders group.

This estimate implies fuel savings of £6,251,520, health-related quality of life savings of £2,604,800 and healthcare losses of £2,780,140. Given total expenditure of £14,780,612 on project implementation this gives a negative ROI of -59%.

Table 2. Health care usage during the last six months

	Intervention group (early cladders)	Intervention group (late cladders)	Control group	Early cladders/control group: mean difference (CI 95%) p-value	Late cladders/control group: mean difference (CI 95%) p-value
Outpatient GP appointments	n=83 mean=2.4 SD=3.4 median=1 IQR=8	n=76 mean=2.4 SD=3.4 median=2 IQR=8	n=62 mean=2.1 SD=2.6 median=1 IQR=6	0.2 (-0.7; 1.1) 0.66	0.28 (-0.69; 1.25) 0.57
GP home visits	n=80 mean=0.2 SD=1 median=0 IQR=1	n=71 mean=0.1 SD=0.1 median=0 IQR=0	n=59 mean=0.2 SD=0.8 median=0 IQR=1	-0.001 (-0.32; 0.32) 0.995	-0.23 (-0.57; 0.1) 0.17
GP telephone conversations	n=83 mean=0.6 SD=1.2 median=0 IQR=2	n=74 mean=0.4 SD=1 median=0 IQR=2	n=59 mean=0.7 SD=1.3 median=0 IQR=4	-0.12 (-0.6; 0.36) 0.6	-0.3 (-0.8; 0.2) 0.2
Practice nurse appointments	n=83 mean=0.9 SD=1.6 median=0 IQR=3	n=77 mean=1.4 SD=2.7 median=1 IQR=7	n=57 mean=1.1 SD=1.8 median=1 IQR=4	-0.14 (-0.73; 0.44) 0.6	0.08 (-0.54; 0.69) 0.8
Hospital admissions (nights spent in the hospital)	n=84 mean=0.9 SD=3.9 median=0 IQR=5	n=77 mean=0.6 SD=2.5 median=0 IQR=4	n=60 mean=0.4 SD=3.9 median=0 IQR=1.5	0.5 (-0.8; 1.8) 0.45	-0.4 (-1.4; 1.3) 0.96
Outpatient hospital clinic appointments	n=79 mean=0.9 SD=1.9 median=0 IQR=4	n=71 mean=1.2 SD=1.8 median=0 IQR=6	n=57 mean=1 SD=2.2 median=0 IQR=8.9	-0.29 (-1.05; 0.47) 0.45	0.09 (-0.7; 0.88) 0.82

Table 3. Fuel usage in the past month

	Intervention group (early cladders)	Intervention group (late cladders)	Control group	Early cladders/control group: mean difference (CI 95%) p-value	Late cladders/control group: mean difference (CI 95%) p-value
Monetary amount spent on gas (£) in the last month	n=60 mean=75 SD=126 median=48 IQR=254	n=56 mean=74 SD=61 median=50 IQR=155	n=44 mean=92 SD=105 median=60 IQR=340	-24 (-58; 9) 0.15	-17 (-52; 18) 0.33
Monetary amount spent on electricity (£) in the last month	n=60 mean=52 SD=58 median=40 IQR=178	n=57 mean=59 SD=36 median=50 IQR=120	n=44 mean=76 SD=85 median=43 IQR=180	-21 (-46; 5) 0.12	-18 (-45; 9) 0.18
Monetary amount spent on both gas and electricity (£) in the last month	n=70 mean=133 SD=182 median=81 IQR=461	n=64 mean=127 SD=135 median=99 IQR=161	n=54 mean=153 SD=151 median=109 IQR=560	-40 (-83; 4) 0.074	-36 (-82; 11) 0.13
Unable to heat the house to a comfortable temperature (number of days in the past month)	n=78 mean=2.8 SD=7 median=0 IQR=20	n=73 mean=2.6 SD=9 median=0 IQR=16	n=59 mean=2.6 SD=6.8 median=0 IQR=20	0.18 (-2.2; 2.5) 0.88	-1.5 (-4; 1) 0.23

Table 4. General health on the day of survey

	Intervention group (early cladders)	Intervention group (late cladders)	Control group	Early cladders/control group: mean difference (CI 95%) p-value	Late cladders/control group: mean difference (CI 95%) p-value
EQ-5D-3L TTO score	n=78 mean=0.68 SD=0.37 median=0.8 IQR=0.9	n=73 mean=0.73 SD=0.33 median=0.8 IQR=0.8	n=57 mean=0.73 SD=0.36 median=0.9 IQR=0.9	0.01 (-0.12; 0.15) 0.85	0.06 (-0.09; 0.2) 0.4
Perceived health state (0-100)	n=83 mean=68 SD=21 median=70 IQR=70	n=75 mean=72 SD=19 median=76 IQR=64	n=61 mean=72 SD=22 median=80 IQR=65	-1.8 (-9.9; 6.3) 0.66	0.5 (-8.04; 9.09) 0.9

Table 5. Household income

	Intervention group (early cladders)	Intervention group (late cladders)	Control group	Early cladders/control group: mean difference (CI 95%) p-value	Late cladders/control group: mean difference (CI 95%) p-value
Total weekly household income (£)	n=45 mean=469 SD=1475 median=180 IQR=1050	n=30 mean=223 SD=252 median=200 IQR=650	n=24 mean=293 SD=297 median=200 IQR=1079		
Total monthly household income (£)	n=40 mean=1897 SD=6221 median=765 IQR=2725	n=36 mean=877 SD=613 median=950 IQR=2500	n=44 mean=1327 SD=1652 median=1000 IQR=2910		
Total annual household income (£)	n=65 mean=18687 SD=58995 median=8760 IQR=33000	n=56 mean=11383 SD=10895 median=11100 IQR=31200	n=51 mean=16195 SD=19700 median=12000 IQR=47920	1528 (-13234; 16291) 0.84	-4719 (-20268; 10830) 0.55

Table 6. Demographics

	Intervention group (early cladders)	Intervention group (late cladders)	Control group
Gender	F=54% M=46%	F=59% M=41%	F=66% M=34%
Age group	25-44=20% 45-64=55% 65-75=13% 75+=12%	15-24=8% 25-44=14% 45-64=42% 65-75=23% 75+=13%	15-24=5% 25-44=39% 45-64=34% 65-75=18% 75+=5%
Marital status	Married=22% Cohabiting=11% Separated=7% Divorced=19% Widowed=15% Never married=26%	Married=32% Cohabiting=8% Separated=5% Divorced=24% Widowed=17% Never married=14%	Married=28% Cohabiting=7% Separated=3% Divorced=18% Widowed=10% Never married=33% Separated, widowed=2%
Education	Masters/PhD=15% 1 st degree=18% HND/NHC/Teaching=28% A level=22% GCSE=17%	Masters/PhD=16% 1 st degree=19% HND/NHC/Teaching=29% A level=25% GCSE=11%	Masters/PhD=27% 1 st degree=18% HND/NHC/Teaching=25% A level=25% GCSE=5%
Number of dependent children under the age of 16	0=76% 1=15% 2=6%	0=73% 1=15% 2=6%	0=70% 1=15% 2=4%

	3=1%	3=1.5% 4=1.5% 5=1.5% 6=1.5%	3=4% 4=7%
Number of people in household	0=12% 1=40% 2=23% 3=12% 4=10% 7=3%	0=4% 1=34% 2=39% 3=12% 4=8% 5=1% 6=1%	0=5.4% 1=29% 2=34% 3=18% 4=5.4% 5=4% 6=5.4%
Employment status	Full time employment=27% Part time employment=14% Retired=26% Housework=5% Caring for someone=1% Unemployed not actively seeking work=13% Unemployed actively seeking work=7% Self-employed=3% Sick Redundant Forced=2%	Full time employment=21% Part time employment=11% Retired=38% Housework=5% Caring for someone=3% Unemployed not actively seeking work=8% Unemployed actively seeking work=4% Self-employed=4% on DVLA=1% ESA=1% Veteran=1% Volunteer work 3 days a week=1% On long term sick=1% Retired/veteran =1%	Full time employment=39% Part time employment=13% Student=3% Retired=22% Housework=5% Caring for someone=3% Unemployed not actively seeking work=8% Unemployed actively seeking work=2% Long term sick=3% Self-employed=2%

Table 7. Project costs

	1) Unit	2). Cost per unit (£)	3). Total number of units	Total cost (£) (column 2 x column 3)	Source
Project implementation costs					
Costs per house:	Per house (terrace, street)	Average £3,432.50*	3,256	£11,176,220	Stockton Council & ECO
Cost of staff: (Community Energy Solutions)	Per individual property	£881	3,256	£2,868,536	Stockton Council & ECO
Other costs:	BT Costs	£116	3,256	£377,696	Stockton Council & ECO
	Enabling Costs	£110	3,256	£358,160	

Total implementation costs:		£4,539.50	3,256	£14,780,612	Stockton Council & ECO
Ongoing maintenance costs					
Costs per house	Per house (terrace, street)	£0			Stockton council
Cost of staff	Per individual	£0			Stockton council
Other maintenance costs		£0			Stockton council
Total maintenance costs		£0			Stockton council

Table 8a. Ongoing benefits: by fuel consumption (per year)

	Early cladders	Control group	Benefit (Adjusted difference between Control group/Early cladders)
Total fuel expenditure per year	£1,596	£1,836	Total fuel saving = $£40 * 12 * 3,256 = £1,562,880$ (3,256 households)

Table 8b. Ongoing benefits: by health-related quality of life (per year)

	Early cladders	Control group	Benefit (Adjusted difference between Control group/Early cladders)
EQ-5D-3L	0.68	0.73	$0.01 * £20,000 * 3,256 = £651,200$ (3,256 participants)

Table 8c. Ongoing benefits: by health care usage (per year)

	Early cladders	Control group	Benefit (Difference between Control group/Early cladders)
Outpatient appointments and hospital admissions	£4,185,665	£3,111,284	-£1,074,381
Medical procedures	£887,609	£1,159,201	£271,592
Medication	£60,254	£168,008	£107,754
Total	£5,133,528	£4,438,493	-£695,035

Table 9. Dividend

Costs (£)	Benefits (£)	
Project implementation= £14,780,612	Fuel (gas and electricity combined)= £1,562,880 (£6,251,520 for the period of 4 years)	
Maintenance= £0	Health-related quality of life = £651,200 (£2,604,800 for the period of 4 years)	
	Healthcare = (-) £695,035 (- £2,780,140 for the period of 4 years)	
Total costs = £14,780,612	Total benefits = £1,519,045 per year (£6,076,180 for the period of 4 years)	Dividend (annual return on investment) (%) = -59%

5. Discussion

Overall, the results are showing no evidence of a significant difference between the study groups. There is a trend toward poorer outcomes for the earlier cladders but this is not statistically significant and may be confounded. We have not been able to demonstrate any improvement in health related quality of life in intervention groups.

Given the characteristics of the groups we would expect the control group to be healthier than the intervention groups. This is because the control group appears to be the youngest and the most educated group. We would expect this to result in participants of this group enjoying better health in general, it was believed that this in turn might have diminished any positive effect of intervention in other study groups. However, controlling for a number of variables (age, income and gender) did not result in a different outcome and no significant difference was observed in health-related quality of life between the study groups.

The reasons for this might be the fact that we do not have a sample large enough to detect the real difference due to a small number of completed questionnaires from all three groups. A difference might exist, but we have not enough data to detect this. The confidence intervals illustrate this as the difference in utilities are wide enough to include important differences favouring either intervention.

A second potential reason is that EQ-5D utility score might not be sensitive enough to identify differences in cold-related health problems. It should be noted that the study participants reported the quality of their overall health and not the impact of cold-related conditions.

For early cladders, the survey took place 4 years after the intervention and any health improvements accumulated during this period of time should have been detected as it is likely that after this period of time the “halo” effect is disappeared. Halo effect refers to the widespread human tendency to assume that once a situation (“house insulation”) possesses some positive characteristics (“an improvement is being done”), other as yet unknown consequences will also be consistent with the existing impression (“I feel better than before”). On the other hand, notable health effects might have also disappeared within this period of time.

In terms of fuel spending, there are a total of 188 households from all study groups for which this data is available. Most households used more than one heating type. Total money saved on fuel is estimated by comparing the data from the control group with an average fuel spending in the early

cladders' intervention group. After adjusting for demographic confounders between the groups the annual value of these savings over the full set of 3,256 insulated households is around £1,563,000.

Healthcare costs were calculated from data available for participants in early cladders and control groups. Compared to control subjects, early cladders require less money on medication and medical procedures, but the NHS cost of outpatient appointments and hospital admissions for this group is higher than that for controls. In total, the annual healthcare usage cost is higher in the early cladders than in control group – this result is consistent with a lower health-related quality of life (EQ-5D score) in these subjects. The annual difference in NHS costs between a total of 3,256 insulated and the same number of non-insulated houses is around £695,000.

As a result of these numbers, a negative ROI of -59% has been calculated. This would mean that 59% of money spent on this project is not returned (lost) within the period of four years. It should be taken into account that these figures only relate to ROI resulting from self-reported fuel spending and healthcare usage; additional benefits to physical, mental and social health are not considered in the methodology of this analysis. Furthermore, as noted above differences in health care usage are likely to be biased because the control group are younger and healthier and so would be expected to use less health care.

There are several limitations to this study. All study participants were selected from officially poor LSOAs (geographically defined), but individual households within the study groups differ widely in terms of their annual income. It might not be the fact that all households are actually experiencing fuel poverty and this might be something to look at in more detail when considering future interventions.

Another important limitation is that healthcare usage data collected is not specific to fuel poverty and cold home-related health problems – it rather includes a wide range of health conditions unrelated to cold housing, some of which are quite expensive (for example, knee replacement, fertility treatment, prostate removal, etc.) in terms of their cost. Other things being equal the groups should be comparable in this respect. However, given the multiplicity of different care that might be needed this might increase the variability between individuals and make it less likely to detect a difference between groups.

In conclusion, evidence from this analysis suggests that external wall insulation is not an effective intervention for reducing total NHS costs. However there is weak evidence suggesting that it is effective at reducing gas and electricity spending by households that are at high risk for fuel poverty. As no quantitative evidence of difference between the study groups was demonstrated, it is

suggested that the evaluation might benefit from qualitative data – interviews and focus groups with cladders to see if they have seen a difference in their health related quality of life after insulation of their house. Qualitative interviews might also provide an insight into psycho-social aspects of recipients' life – they might experience less stress, better mental health and better social life, as a result.

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7. Appendices

Appendix 1. Sample questionnaire

Section 1: Health Care Usage

Please complete this section on your health care usage over the past six months.

Please tick the appropriate boxes and answer the questions where required.

**THIS SET OF QUESTIONS IS ABOUT ANY APPOINTMENTS YOU MAY HAVE HAD WITH
A GENERAL PRACTICE IN THE PAST 6 MONTHS**

1. Have you consulted a GP for any reason during the last 6 months?

Yes **If Yes, go to Q1a**

No **If No, go to Q2**

1a. How many appointments did you attend with a GP at their practice in the last six months?

1b. How many times did a GP visit you at home in the last six months?

1c. How many times did you have a telephone conversation with a GP in the last six months?

THIS SET OF QUESTIONS IS ABOUT ANY APPOINTMENTS YOU MAY HAVE HAD WITH OTHER HEALTH CARE WORKERS IN THE PAST 6 MONTHS

2. During the last 6 months have you had an appointment with:

A Practice Nurse? Yes If Yes, how many appointments did you have?

 No

Other? (please specify) Yes

 No

_____ How many appointments did you have?

_____ How many appointments did you have?

THIS SET OF QUESTIONS IS ABOUT ANY MEDICATION OR MEDICAL PROCEDURES YOU MAY HAVE HAD IN THE PAST 6 MONTHS

3. In the last 6 months, have you had any medical tests or procedures? (e.g. blood tests)

Yes **If Yes, go to Q3a**

No **If No, go to Q4**

3a. If you have had any medical tests or procedures in the past 6 months, please provide details below:

Test	Number of tests
1. _____	<input type="text"/>
2. _____	<input type="text"/>
3. _____	<input type="text"/>
4. _____	<input type="text"/>
5. _____	<input type="text"/>

4. Are you taking any medication daily?

Yes **If Yes, go to 4a**

No **If No, go to 5**

4a. If Yes, please list the medications you are currently taking below:

Medication

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____

THIS SET OF QUESTIONS IS ABOUT ANY APPOINTMENTS YOU MAY HAVE HAD AT THE HOSPITAL IN THE PAST 6 MONTHS

5. In the last **6** months, have you had an admission to hospital as an inpatient?

Yes **If Yes, go to Q5a**

No **If No, go to Q6**

5a. If Yes, approximately how many nights in total did you spend in hospital in the last **6** months (if you were only admitted as a day case enter 0)?

Enter number of nights that you stayed in hospital

6. In the last **6** months, have you had any outpatient hospital clinic appointments?

Yes **If Yes, go to Q6a**

No **If No, go to section 2**

6a. If Yes, approximately how many hospital clinic appointments in total did you have in the last **6** months?

Enter number of times you attended hospital clinic appointments

Section 2: Fuel Usage

THIS SET OF QUESTIONS IS ABOUT YOUR FUEL USAGE OVER THE PAST 1 MONTH

1. In the last month how much have you spent on fuel (gas and electricity) to heat and power the home?

If possible please indicate gas and electricity costs separately

Put cost here:

1. Amount spent on gas:
2. Amount spent on electricity:
3. Total amount spent on fuel to heat
and power the home:

1b. In the last month have you been able to keep the house heated to a comfortable temperature?

- Yes **If Yes, go to Section 3**
- No **If No, go to Q1c**

1c. If NO, how many days in the past month have you not been able to keep the house heated to a comfortable temperature?

Please list number of days below:

Section 3: General Health

THIS SET OF QUESTIONS IS ABOUT YOUR GENERAL HEALTH TODAY

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.

Mobility

- I have no problems in walking about
- I have some problems in walking about
- I am confined to bed

Self-Care

- I have no problems with self-care
- I have some problems washing or dressing myself
- I am unable to wash or dress myself

Usual Activities (*e.g. work, study, housework, family or leisure activities*)

- I have no problems with performing my usual activities
- I have some problems with performing my usual activities
- I am unable to perform my usual activities

Pain / Discomfort

- I have no pain or discomfort
- I have moderate pain or discomfort
- I have extreme pain or discomfort

Anxiety / Depression

- I am not anxious or depressed
- I am moderately anxious or depressed
- I am extremely anxious or depressed

Best imaginable
health state

To help people say how good or bad a health state is, we have drawn a scale (rather like a thermometer) on which the best state you can imagine is marked 100 and the worst state you can imagine is marked 0.

We would like you to indicate on this scale how good or bad your own health is today, in your opinion. Please do this by drawing a line from the box below to whichever point on the scale indicates how good or bad your health state is today.

**Your own health
state today**



Worst imaginable
health state

OTHER INFORMATION

Section 4: Demographic information

1. Are you male or female?

Male

Female

2. Which age group do you belong to?

15-24

25-44

45-64

65-75

75+

3. What is your current marital status?

Married

Cohabiting

Separated

Divorced

Widowed

Never Married

4. What was your highest level of qualification when you finished your education?

Masters/PhD

1st Degree

HND/HNC/Teaching

A level

GCSE /O-level

No Qualifications

Other

5. How many dependent children under the age of 16 are you responsible for?

Number of children under the age of 16:

6. If applicable, what is the age of the **youngest** dependent child under the age of 16 that you are responsible for?

Age of youngest dependent child:

7. Including dependent children, how many people are currently living at your household?

Number of people in household:

8. What is your current employment status?

Full Employment <input type="checkbox"/>	Part-time Employment <input type="checkbox"/>
Student <input type="checkbox"/>	Retired <input type="checkbox"/>
Housework <input type="checkbox"/>	Caring for someone <input type="checkbox"/>
Unemployed, not actively seeking work <input type="checkbox"/>	Unemployed, actively seeking work <input type="checkbox"/>
Other Please provide details: _____ <input type="checkbox"/>	

9. What is your weekly or monthly disposable household income (income remaining after taxes and national insurance contributions)? Please provide a total for all household members.

Total *weekly* disposable household income:

£ _____

OR

Total *monthly* disposable household income:

£ _____

