Assessing the effect of grants for home energy efficiency improvements

Les Shorrock, Building Research Establishment Ltd

NOTE: The pdf published at www.eceee.org has different formatting and pagination than the paper printed in the 2001 eceee summer study proceedings. However, the content is identical.

1. SYNOPSIS

Data on three key energy efficiency measures are analysed, showing increased uptake due to grants. Large carbon emission reductions are calculated, even allowing for free-riders.

2. ANALYSES AND FINDINGS

This paper presents analyses of the effects of home energy efficiency grants using historical data on several United Kingdom grant schemes and data on acquisitions or sales of individual measures. It follows a previously reported approach that primarily focused on loft insulation[1] but it extends the analyses undertaken, introduces further data, and considers further measures. The paper clearly shows that for three key energy efficiency measures (loft insulation, cavity wall insulation and condensing boilers) the presence of grants increased the acquisitions of those measures, leading to large carbon emission savings.

This is illustrated in Figure 1 for loft insulation in existing homes. It is obvious from this that there is a strong link between the uptake and the grant expenditure in each year (expressed in 1999/2000 money values), but note that the relationship that is observed seems to be different before and after about 1988.

Figure 2 presents the pre-1988 data in a different format that demonstrates clearly that the grants increase uptake by about 4.1 thousand per year per £M expenditure (2.7 thousand per year per EUR M expenditure). However, the slope of the grants line is greater, implying that when expenditures reach about £100M/year (EUR150M/year) all loft insulation acquisitions in existing homes are with grant aid. At this point and above, there are approximately 307 thousand households (i.e. the intercept of the acquisitions line on the x-axis) benefiting from grants that would have installed the measure anyway. Thus, there is a “free-rider” effect whereby householders that would have acquired the measure anyway, without a grant, take advantage of the availability of a grant. The data can be further analysed to show that there is a very high level of confidence (> 99.5%) that there is a free-rider effect present.

Figure 3 presents the loft insulation data from 1988 onwards. The slopes of the two lines are much less than shown on Figure 2. This is related to changes to the grants that occurred in 1988 to make them more targeted to low-income households, and to the fact that loft insulation ownership, after growing rapidly prior to 1988, began to increase at a much reduced rate as saturation was approached. The data still show the presence of a free-rider effect (i.e. the two lines on Figure 3 eventually cross when extended to higher expenditure levels), which turns out to be much the same as the pre-1988 characteristic. Data on Figure 3 can be further analysed to indicate a more than 95% confidence that there is a free-rider effect.

Figure 4 presents a similar analysis for cavity wall insulation. Grants for cavity wall insulation only became available in 1994/95, so there are only six years of grants data on which to base the analysis. Nonetheless, the available data indicate that grants increase the uptake rate by about 3.4 thousand per £M/year expenditure (2.3 thousand per M EUR/year). The results also indicate, with about 70% confidence, that there is a free-rider effect for this measure (about 97,000 free-riders at a grant expenditure of £190M/year, EUR285M/year, or more).

In the case of condensing boilers, there is very little data available (only four years for which grants were available). Hence the findings are necessarily preliminary and have not been presented graphically in this paper. The analysis is also complicated by the fact that the sales were already on a strongly rising trend before the grants were introduced. However, correcting for this suggests that the grants increase the uptake by about 1.8 thousand per £M/year expenditure (1.2 thousand per M EUR/year). In contrast, the number of grants increases at

a higher rate (3.4 thousand per £M/year expenditure, or 2.2 thousand per M EUR/year), indicating the presence of a free-rider effect.

Energy and carbon savings

Calculations summarised in Table 1 indicate that, due to the combined effect of the grants, the UK housing stock currently consumes approximately 100 PJ/year less than it would otherwise do, resulting in an emissions reduction of 1.8 MtC/year. These savings are based on estimates of typical energy savings for each of the measures, drawn from the work presented in ECEEE poster 1185² (2), taking account of the relevant fuel mix and emission factors that applied in each individual year. Cumulatively, since their inception, the grants have saved about 1500 PJ and 28 MtC. All these figures reduce by 40% when free-riders are discounted. The overall net cost per tonne of carbon saved is
-£272/tC (-EUR408/tC) (i.e. a net benefit of £272/tC), reduced to -£241/tC (-EUR361/tC) allowing for free-riders. Thus, the grants were highly cost-effective, even allowing for free-riders.

Figure 1 – Loft insulation acquisitions & grants

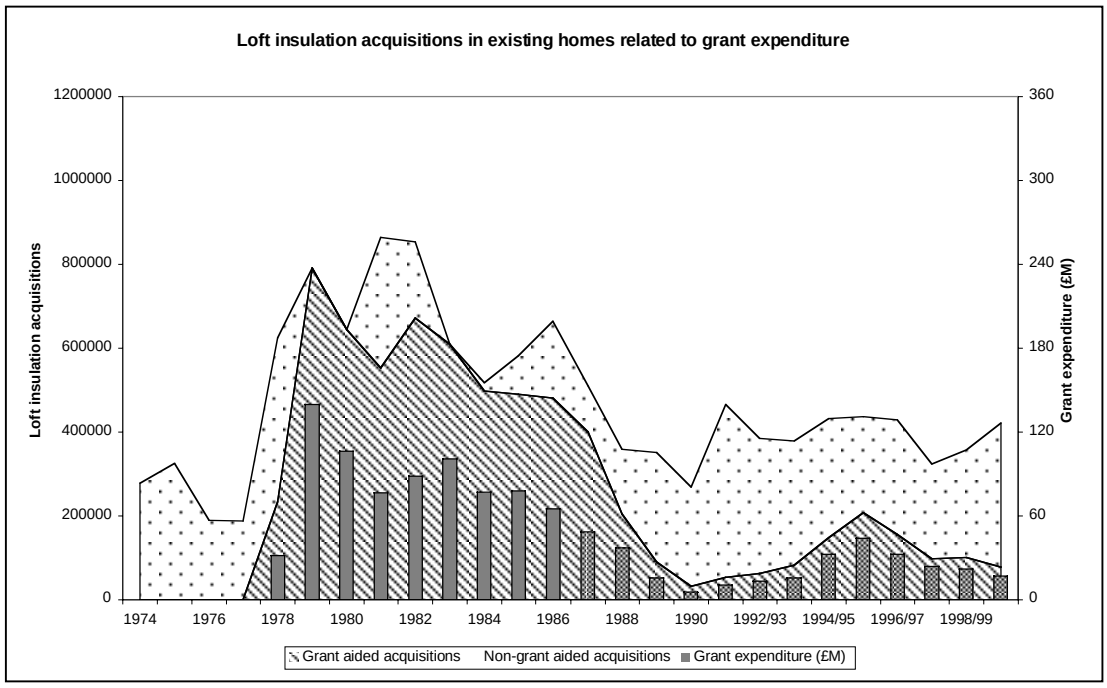


Figure 2 – Pre-1988 loft insulation analysis

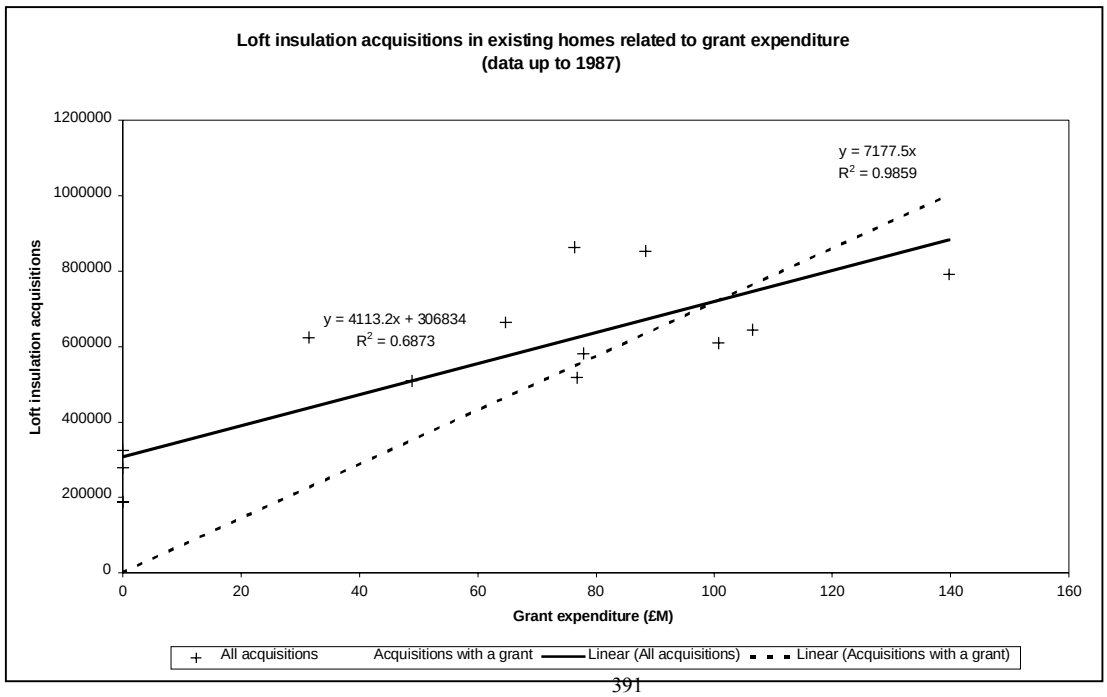


Figure 3 – Loft insulation analysis from 1988

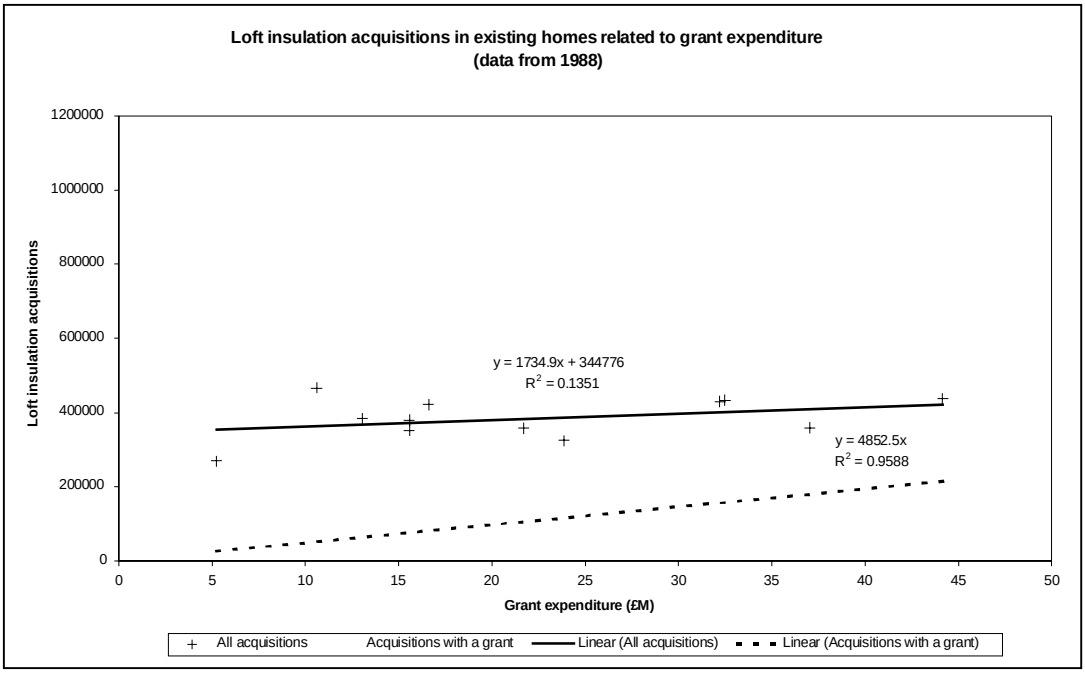
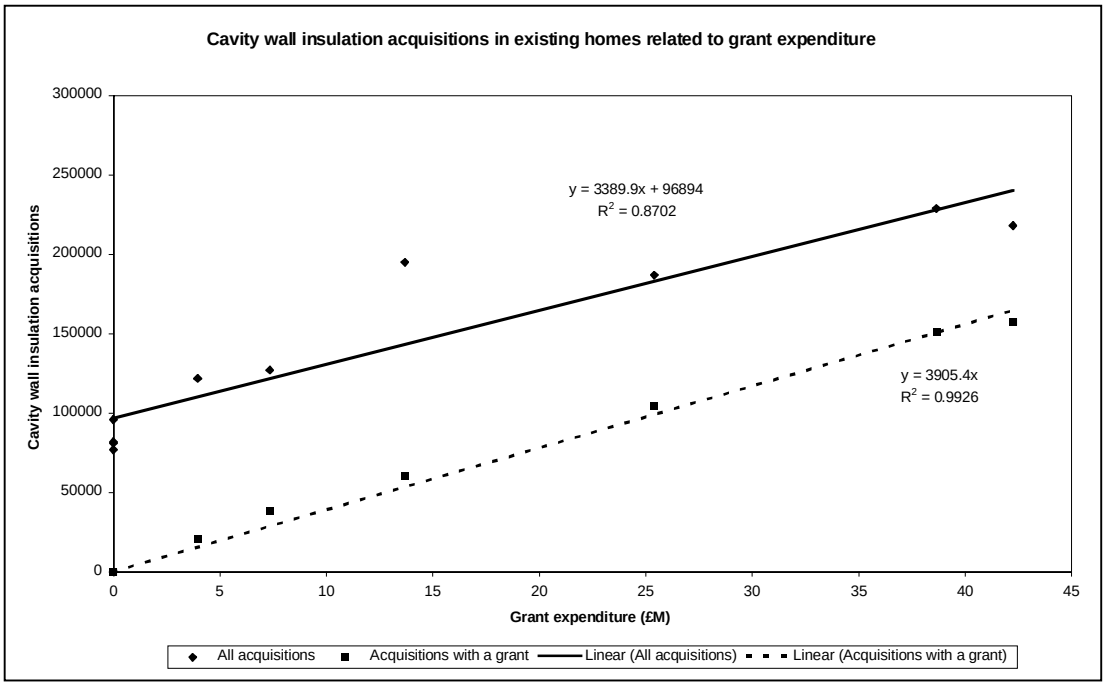


Figure 4 – Cavity wall insulation analysis



					Not allowing for free-riders								Allowing for free-riders							
	Cumulative acquisitions from start of grants	Cumulative grants	Cumulative non free-rider grants	Cumulative grant expenditure (£M 1999/2000)	Savings in that year (PJ)	Cumulative savings (PJ)	Savings in that year (MtC)	Cumulative savings (MtC)	Cumulative cost saving (£M 1999/2000)	Saving/cost ratio	Cost per tonne of carbon saved (£/tC)	Net cost per tonne of carbon saved (£/tC)	Savings in that year (PJ)	Cumulative savings (PJ)	Savings in that year (MtC)	Cumulative savings (MtC)	Cumulative cost saving (£M 1999/2000)	Saving/cost ratio	Cost per tonne of carbon saved (£/tC)	Net cost per tonne of carbon saved (£/tC)
1978	624000	233592	137157	31.5	3.3	3.3	0.07	0.07	19.5	0.62	439	167	1.9	1.9	0.04	0.04	11.5	0.36	747	475
1979	1415000	1287310	884041	171.2	17.9	21.2	0.39	0.47	114.7	0.67	367	121	12.3	14.2	0.27	0.31	76.8	0.45	547	302
1980	2059000	2074607	1364504	277.7	28.5	49.8	0.60	1.06	261.9	0.94	262	15	18.8	33.0	0.39	0.71	173.7	0.63	394	148
1981	2922000	2627874	1683664	354.1	36.1	85.9	0.73	1.79	472.9	1.34	198	-66	23.2	56.2	0.47	1.17	309.0	0.87	303	39
1982	3775000	3299845	2084773	442.5	45.9	131.8	0.90	2.68	785.8	1.78	165	-128	29.0	85.2	0.57	1.74	506.6	1.14	255	-37
1983	4384000	3950921	2429015	543.3	55.5	187.2	1.06	3.75	1190.1	2.19	145	-173	34.0	119.2	0.65	2.39	754.9	1.39	228	-89
1984	4901000	4448367	2691157	620.1	62.1	249.3	1.15	4.89	1636.8	2.64	127	-208	37.5	156.8	0.70	3.08	1025.0	1.65	201	-131
1985	5482000	4938407	2942403	698.0	67.5	316.8	1.30	6.19	2111.5	3.02	113	-228	40.3	197.1	0.78	3.86	1308.5	1.87	181	-158
1986	6146000	5418573	3224159	762.8	72.6	389.4	1.40	7.59	2612.1	3.42	100	-244	43.3	240.4	0.83	4.69	1607.2	2.11	163	-180
1987	6655000	5817577	3473491	811.6	77.1	466.5	1.48	9.07	3114.6	3.84	89	-254	46.1	286.5	0.88	5.58	1907.7	2.35	146	-197
1988	7013000	6021908	3562273	848.7	79.4	545.8	1.50	10.57	3605.4	4.25	80	-261	47.1	333.6	0.89	6.47	2199.0	2.59	131	-209
1989	7364000	6112780	3604500	864.3	80.5	626.3	1.49	12.06	4093.5	4.74	72	-268	47.6	381.2	0.88	7.35	2487.8	2.88	118	-221
1990	7633000	6145407	3620709	869.5	80.9	707.2	1.49	13.55	4580.6	5.27	64	-274	47.8	429.0	0.88	8.23	2775.7	3.19	106	-232
1991/92	8098000	6199358	3641544	880.2	81.5	788.7	1.51	15.06	5068.9	5.76	58	-278	48.1	477.1	0.89	9.12	3063.6	3.48	97	-239
1992/93	8482000	6261341	3662788	893.2	82.3	871.0	1.51	16.57	5540.9	6.20	54	-281	48.3	525.4	0.89	10.01	3340.9	3.74	89	-245
1993/94	8860000	6343369	3696157	908.8	83.2	954.1	1.47	18.04	6007.6	6.61	50	-283	48.7	574.1	0.86	10.87	3614.0	3.98	84	-249
1994/95	9414000	6511620	3761035	945.3	85.2	1039.3	1.51	19.55	6505.3	6.88	48	-284	49.5	623.6	0.88	11.75	3903.3	4.13	80	-252
1995/96	9977000	6757577	3865432	996.8	88.1	1127.4	1.59	21.13	7010.5	7.03	47	-285	50.8	674.4	0.93	12.67	4194.7	4.21	79	-252
1996/97	10628263	6979390	3975695	1045.3	90.8	1218.2	1.63	22.76	7484.5	7.16	46	-283	52.3	726.6	0.95	13.63	4467.5	4.27	77	-251
1997/98	11172803	7190247	4095203	1097.0	93.6	1311.8	1.69	24.45	7970.7	7.27	45	-281	54.0	780.6	0.99	14.62	4747.9	4.33	75	-250
1998/99	11789128	7459491	4269438	1164.4	97.3	1409.1	1.75	26.20	8438.7	7.25	44	-278	56.5	837.1	1.04	15.65	5019.7	4.31	74	-246
1999/00	12490828	7704149	4435341	1224.2	100.7	1509.7	1.81	28.01	8845.3	7.23	44	-272	58.9	896.0	1.08	16.73	5257.8	4.29	73	-241

3. END NOTES

[1] An analysis of the effect of Government grants on the uptake of home insulation measures.
L D Shorrock. Energy Policy 27, 155-171, 1999.

[2] Cost-effective energy and carbon savings in the UK housing stock. G. Henderson. ECEEE 2001 Summer Study. Paper 1185.