

Supplementary Materials: A Simple Assessment of Housing Retrofit Policies for the UK: What Should Succeed the Energy Company Obligation?

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1. Economic data for retrofit measures and Energy Performance Certificate (EPC) band upgrades

The capital cost of retrofit and annual energy bill savings were obtained from existing literature, along with estimated annual CO₂ savings of each energy-saving measures (). The annual CO₂ savings are not directly used in the profit-and-loss analysis, but rather to assess the ability of each policy proposal to reduce CO₂ emissions. The data in Table S1 were used to estimate the capital cost (CAPEX) of individual and multiple EPC upgrades in the profit-and-loss analyses of EPC-based policies. The minimum and maximum CAPEX data were used to assess the discrepancies between the best-case and worst-case cost scenarios, respectively (Dowson and Poole, 2012).

Table S1. Capital cost (CAPEX), energy bills savings and CO₂ savings data for selected retrofit measures. The figures presented are for gas-heated, semi-detached houses, which make up the bulk of housing stock in England, Scotland and Wales. (EST, 2016; Dowson and Poole, 2012).

Energy-saving measure	Min. CAPEX (£)	Max. CAPEX (£)	Annual energy bill savings (£)	Annual CO ₂ savings (kgCO ₂)	EPC band upgrade
Solid wall insulation (internal)	4,000	14,000	260	1,800	F – E
Solid wall insulation (external)	8,000	22,000	260	1,900	F – E
Loft insulation (0-300 mm)	254	273	180	730	G – F
Loft insulation (50-300 mm)	211	254	145	420	G – F
Loft insulation (100-300 mm)	199	211	25	110	G – F
Loft insulation (150-300 mm)	170	199	17.05	75	G – F
Loft insulation (200-300 mm)	100	170	10.23	45	G – F
Cavity wall insulation	500	1,500	140	650	F – E
Draught proofing	120	290	30	120	G – F
Condensing gas boiler	2,200	3,000	310	1,200	D – C
Improved heating controls	350	450	70	280	C – B
Energy efficient light bulbs	50	85	35	111	E – D
Solar water heating	4,000	6,000	60	270	B – A
Windows double glazing (A-rated)	3,000	5,000	110	650	E – D
Insulation of pipes/radiators	15	50	115	500	F – E

2. Definition of customer and systemic profits and losses

To conduct the profit-and-loss analyses, the customer and systematic profits and losses were identified for each policy proposal (Table S2 and Table S3).

Table S2. Definition of customer profit and loss in the economic viability analysis. Note that for private rented properties, it was assumed that the landlords incur the full cost of installation.

Policy	Customer	Customer profit	Customer losses
Variable Council Tax (VCT)	Homeowners	Council Tax discounts Energy bill savings	Council Tax penalties Capital cost of retrofit
	Landlords	Increased demand for property ¹	Capital cost of retrofit
	Tenants	Council Tax discounts Energy bill savings	Council Tax penalties Capital cost of retrofit
Variable Stamp Duty Land Tax (VSDLT)	Property sellers	Increase in property value Energy bill savings	Capital cost of retrofit
Green Mortgage (GM)	Property buyers	Stamp Duty Land Tax (SDLT) rebate	SDLT penalty
	Mortgage holders /potential buyers	Energy bill savings	Monthly principal mortgage payments Annual interest payments

Table S3. Definition of systemic profit and loss in the economic viability analysis.

Policy	Spender	Systemic profit	Systemic losses	
			Fixed	Variable
VCT	UK Treasury	Council Tax penalties	Council Tax discounts	One-off Council Tax rebates
VSDLT	UK Treasury	SDLT penalties	SDLT rebates	Marketing expenses
GM	Lending institutions	Accumulated mortgage repayments and interest in year 10	Mortgage offer improves for property buyers (£2,500 per EPC band upgrade)	Marketing expenses
			Mortgage extension offers	

3. Values of scheme penalties and rewards

Assumptions on the value of penalties and rebates (VCT and VSDLT) were made based on the objectives of the original policy briefs and used to produce additional economic data (Table S4).

Table S4. Assumed values of VCT rebates and penalties (UKGBC, 2013; Howard, 2016).

Policy proposal	Profit/loss type	Value	
VCT	Council tax penalty	Household EPC band	Council tax adjustment (% of baseline tax rate)
		G	+19%
		F	+9%
	Council tax rebate	E	0%
		D	-8%
		C	-15%
	B	-21%	

¹ As a “bills-inclusive” basis is assumed, the profit to landlords of privately rented properties is considered to result from increased property prices, due to lower energy and Council Tax bills.

		A	-27%
		Household EPC band	SDLT adjustment (% of baseline tax rate)
	SDLT penalty	G	+23%
		F	+18%
VSDLT		E	+8%
		D	0%
		C	-15%
	SDLT rebate	B	-25%
		A	-32%

The increase in property value of households following improvement of energy efficiency (relevant for the VSDLT and GM schemes) is shown in Table S5.

Table S5. Assumed percentage value increase of a household upon Energy Performance Certificate (EPC) upgrade, assuming a 3-bed, semi-detached gas-heated property with a selling value of £220,000 (Gov.uk, 2016).

EPC band upgrade (neutral band D)	Increase in property value
G – D	£49,486
F – D	£34,200
E – D	£17,600
D – C	£22,000
D – B	£45,716
D – A	£55,800

4. Customer base of policy proposals

To calculate the systemic costs of deploying each policy proposal, estimated annual uptake values were derived from initial policy proposals.

Table 1. Estimated uptake of each policy proposal. Sources: [11], [37].

Policy proposal	Duration of scheme (years)	Minimum annual uptake (number of households)	Maximum annual uptake (number of households)
VCT	6	518,000	1,480,000
VSDLT	6 or 7	135,000	270,000
GM	6	136,000	272,000

5. Fixed costs of scheme deployment

To estimate the average annual financial burden of each policy proposal, the fixed costs of deploying each scheme were estimated and are shown in Table S7. These costs were added to the delivery costs of each policy, which varied with estimated customer uptake and are a product of the cost of measure installation and the size of the customer base (see Section 4.2). They consist of marketing and administrative costs, as well as the cost of subsidising EPC assessments in fuel-poor households, in the case of the VCT scheme.

The initial and annual marketing/administrative costs of the policies were extrapolated from the marketing/administrative costs of the Green Deal [59]. The available data for the marketing/administrative costs of ECO is not verified [60].

For schemes requiring households to conduct EPC assessments, it was expected that the funding agencies would subsidize the cost of assessments for fuel-poor households, to avoid undue burden

being placed on low-income residents by the entities conducting the assessments. The cost of conducting EPC assessments in these households was extrapolated from the average cost of undertaking a household assessment in the UK, set at £90 [61] and the percentage of fuel-poor households lacking an EPC assessment, estimated at 42% of all fuel-poor households at the time of writing [62].

Table S2. Estimated fixed costs of deployment for each policy proposal.

Policy proposal	Total fixed cost of deployment	Source of fixed costs
VCT	£142.5 million	EPC assessments Marketing/administrative costs
VSDLT	£42.3 million	Marketing/administrative costs
GM	£42.3 million	Marketing/administrative costs