Appendix T: Improvement measures

The table defines the circumstances under which recommendations for improvements are made.

For England & Wales and Scotland software tests for the relevance of improvement measures, and applies them where relevant, in the order shown in this table. Several heating measures apply when mains gas is not available. When mains gas is available they are substituted by a fuel switch recommendation (item T).

Items Q2, J2, Z1, Z2, Z3 are alternative measures. They are shown on the EPC where relevant to the property; Q2 when there is a recommendation for cavity fill and the others when there is a recommendation to change or upgrade the heating system.

For Northern Ireland the sequence is A to H, A2, A3, W, X, Y, I, T2, J to V (not alternative measures).

In the case of new dwellings only items E, N, U and V are considered.

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
A	Loft insulation Note. This is assumed to include insulation of the loft hatch.	Pitched roof (slates or tiles), accessible loft, insulation at ceiling level, not thatched roof. Note: This does not include insulation of a room-in-roof	<= 150 mm insulation or U-value entered by assessor >= 0.35	250 mm insulation. See Note 2
A2	Flat roof insulation	Flat roof, insulation as built or insulation thickness 50 mm	Flat roof insulation < 100 mm or flat roof U-value (entered or from RdSAP tables if as-built) > 0.4	Flat roof U-value = 0.18
A3	Roof room insulation	Roof rooms	Any part of roof rooms with less than 100 mm insulation or U > 0.5	U-value of all elements of roof rooms with U > 0.5 have U = 0.25
B	Cavity wall insulation	Unfilled cavity wall (assessed as "as built" and not "unknown")	Wall U-value (as entered by assessor or assumed from RdSAP tables) > 0.6	Cavity filled wall. U-value from RdSAP tables according to age of wall. See Note 3
Q	Solid wall insulation	Solid wall, stone or brick (assessed as "as built" and not "unknown")	Wall U-value (as entered by assessor or assumed from RdSAP tables) > 0.6	Internal or external wall insulation with U-value 0.3. See Note 7

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
Q2	External insulation with cavity wall insulation (Alternative measure).	Cavity walls	Cavity fill recommendation	Wall U-value = 0.3
W	Floor insulation	Below the building part there is: - ground, or - external air, or - unheated space and floor is as-built or has retro-fitted insulation (not unknown)	Floor as-built, age band A to J	Include floor insulation of 150 mm (ground floor) or retro-fit insulation
			Ground floor with retro-fit insulation: - thickness 50 mm, or - specified U-value > 0.5	Change to 150 mm floor insulation
C	Hot water cylinder insulation	Cylinder present and accessible.	No cylinder insulation	80 mm jacket
			Factory-applied insulation <= 25 mm	Add 80 mm jacket. See Note 1a.
			Jacket < 80 mm	Add additional jacket. See Note 1b.
D	Draught proofing	Existing dwelling	Less than 100% draught proofing of windows and doors	100% draught proofing
E	Low energy lights	Existing dwelling	LEL < 100% of fixed outlets	LEL in all fixed outlets
		New dwelling	LEL < 75% of fixed outlets	LEL in all fixed outlets
F	Cylinder thermostat	Cylinder present and accessible	No cylinderstat (Note: cylinderstat is assumed for electric immersions)	Cylinderstat

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
G	Heating controls for wet central heating system	Main heating by boiler with radiators	No controls	Roomstat, programmer and TRVs
			Programmer only	do.
			Roomstat only	do.
			Programmer, single roomstat (no TRVs)	do.
			TRVs (no roomstat or BEM), with or without programmer	do.
			Programmer and at least two roomstats	Time and temperature zone control
		Main heating by boiler with underfloor heating	Less than time and temperature zone control	Time and temperature zone control
		Main heating by heat pump with radiators or underfloor heating	Less than time and temperature zone control	Time and temperature zone control
H	Heating controls for warm air system	Main heating by mains gas or LPG warm air, or by heat pump	No control	Programmer and roomstat
			Programmer only	do.
J	Biomass boiler	Independent solid fuel boiler (not biomass or dual fuel)	Mains gas not available	Manual feed biomass boiler in heated space (wood logs) with radiators. See Note 8.
K	Biomass room heater with boiler	Solid fuel open fire with or without boiler (not biomass or dual fuel)	Mains gas not available	Wood pellet stove with radiators, summer immersion heater. See Note 8.
		Solid fuel room heater with or without boiler (not biomass or dual fuel)	Mains gas not available	Wood pellet stove with radiators, summer immersion heater. See Note 8.
J2	Biomass boiler (Alternative measure).	Heating other than by solid fuel or community	Heating system recommendation	Wood logs boiler. See Note 8

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
Z1	Air or ground source heat pump (Alternative measure).	Heating other than by: - heat pump or - community or - wet underfloor system	Heating system recommendation	Air source heat pump and radiators. See Note 9
Z2	Air or ground source heat pump with underfloor heating (Alternative measure).	Heating other than by: - heat pump or - community and wet underfloor system and Z1 not applicable	Heating system recommendation	Air source heat pump and underfloor heating. See Note 9
Z3	Micro-CHP (Alternative measure).	Heating other than by micro-CHP or community	Heating system recommendation	Heating by micro-CHP. See Note 10
I	Upgrade boiler, same fuel	Main heating by mains gas boiler (including range cooker boiler) or CPSU or by LPG or oil boiler (including range cooker boiler) and mains gas not available Note. Not applicable to liquid biofuels.	Boiler, not condensing, hot water cylinder in dwelling	Condensing regular boiler, same fuel as original. See Note 4
			Boiler, not condensing, no hot water cylinder in dwelling	Condensing combi boiler, same fuel as original. See Note 4
			CPSU, not condensing	Condensing CPSU. See Note 5
			Range cooker boiler, hot water cylinder in dwelling	Condensing regular boiler, same fuel as original. See Note 4
			Range cooker boiler, no hot water cylinder in dwelling	Condensing combi boiler, same fuel as original. See Note 4
R	Condensing oil boiler	Main heating by oil warm air	Mains gas not available, hot water cylinder in dwelling	Condensing regular oil boiler, radiators. See Note 4
			Mains gas not available, no hot water cylinder in dwelling	Condensing combi oil boiler, radiators. See Note 4
S	Change heating to condensing gas condensing boiler (no fuel switch)	Main heating by mains gas fires	Hot water cylinder in dwelling	Condensing regular mains gas boiler, radiators. See Note 4
			No hot water cylinder in dwelling	Condensing combi mains gas boiler, radiators. See Note 4

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
T	Change heating to condensing gas condensing boiler (fuel switch)	Main heating by: - solid mineral fuel boiler - LPG boiler (non-condensing) - oil boiler (non-condensing) - LPG fires - oil warm air - solid mineral fuel room heaters - oil room heaters - electric room heaters - electric ceiling heating Also if no space heating system present	Mains gas available, hot water cylinder in dwelling	Condensing regular mains gas boiler, radiators. See Note 4
			Mains gas available, no hot water cylinder in dwelling	Condensing combi mains gas boiler, radiators. See Note 4
		Main heating by: - electric storage heating - electric off-peak underfloor heating	Mains gas available, hot water cylinder in dwelling	Condensing regular mains gas boiler, radiators. Change electricity meter to single. See Note 4
			Mains gas available, no hot water cylinder in dwelling	Condensing combi mains gas boiler, radiators. Change electricity meter to single. See Note 4
		Main heating by LPG CPSU	Mains gas available	Mains gas condensing CPSU
T2	Flue gas heat recovery	New or replacement gas boiler recommended (I, S or T)	Replacement boiler provides DHW	Add FGHRS

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
L	New or replacement storage heaters	Main heating by storage heaters, Old (large volume) or Modern (slimline)	Mains gas not available, and hot-water heating by cylinder with single immersion, or from solid-fuel secondary heater	Fan-assisted storage heaters with automatic charge control, and dual immersion water heating, large cylinder with 50 mm factory-applied insulation
			Mains gas not available, and any other hot water system	Fan-assisted storage heaters with automatic charge control
		Main heating by: - electric room heaters - electric ceiling heating Also if no space heating system present	Mains gas not available, and hot-water heating by cylinder with single immersion or from solid-fuel secondary heater or no hot water system present	Fan-assisted storage heaters with automatic charge control, 7-hour off-peak tariff and dual immersion water heating, large cylinder with 50 mm factory-applied insulation
			Mains gas not available, and any other hot water system	Fan-assisted storage heaters with automatic charge control, 7-hour off-peak tariff
M	Replacement warm-air unit	Main heating by mains gas or LPG warm air	Age before 1998	New (non-condensing) warm-air unit, same fuel as original, on-off control, fan-assisted flue

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
N	Solar water heating	RdSAP assessment, house or bungalow, not thatched roof on main dwelling	No solar panel	Solar panel with parameters per Table S18. Increase a normal size cylinder to medium (see * below).
		SAP assessment, house or bungalow	No solar panel	Solar panel, 3 m² aperture area, evacuated tube with η=0.70, a_1=1.80, facing South, pitch 30°, modest overshading. Combined DHW cylinder at least 190 litres (see * below), solar part 75 litres; or if combi boiler, CPSU or instantaneous water heater, a separate solar pre-heat cylinder of 75 litres.
			All cases:	* Cylinder change not applicable to water heating by combi boiler or CPSU or heat pump or micro-CHP with integral DHW vessel or instantaneous water heater or community heating. In these cases add a separate solar cylinder of 75 litres. A replacement cylinder has the same insulation thickness or, if measured loss, a loss scaled by the volume and volume factors of the original and replacement cylinders.
Y	Waste water heat recovery	Dwelling has a mixer shower and no WWHRS	WWHRS not present	Add WWHRS for each shower.
O	Double glazing	Single glazed windows present	Less than 80% of windows with multiple glazing	If all windows measured, all single glazed windows replaced by double glazing with U = 1.5 and g = 0.63. Otherwise the windows with single glazing changed to double glazing with U = 1.5 and g = 0.63.

Item	Measure	To be considered when existing dwelling is/has:	Recommended if existing dwelling has:	Improve to:
P	Secondary glazing	Single glazing present but assessor de-selected measure O. See Note 6	Less than 80% of windows with multiple glazing	If all windows measured apply secondary glazing to single glazed windows with U = 2.4 and g = 0.76. Otherwise the windows with single glazing changed to secondary glazing with U = 2.4 and g = 0.76.
X	Insulated doors	House or bungalow or (Flat or maisonette) and (no corridor or more than one door) i.e. door directly to outside	Door(s) directly to outside not insulated	Change doors directly to outside to insulated doors with U = 1.5
U	Photovoltaics	Existing dwelling, house or bungalow, not thatched roof	Photovoltaics less than 1.0 kWp	Photovoltaics, 2.5 kWp (2.5 kWp in total, including any existing)
		New dwelling, house or bungalow	No photovoltaics	Photovoltaics, 2.5 kWp, facing South, pitch 30°, modest overshading,
V	Wind turbine	House or bungalow	No wind turbine	1 wind turbine, blade diameter 2.0 m, hub height 2.0 m

Note 1a. SAP Table 2 is constructed on the basis that 80 mm jacket is equivalent to 25 mm factory-applied insulation. Therefore an additional 80 mm jacket can be implemented by increasing the existing insulation thickness by an additional 25 mm, to the nearest RdSAP thickness option for cylinders. Thus 12 mm improves to 38 mm, and 25 mm improves to 50 mm.

Note 1b. 12 or 25 mm improves to 80 mm, and 38 or 50 mm improves to 120 mm.

Note 2. Loft insulation is considered separately for main roof and extensions 1, 2, 3, 4 as applicable and applied to all accessible roofs with insulation <= 150 mm. On the EPC the total cost saving for the measure is shown without any mention of “main”, “extension”, etc.

Note 3. Cavity wall insulation is considered separately for main wall, extensions 1, 2, 3, 4 and alternative walls as applicable and applied to all fillable walls. On the EPC the total cost saving for the measure is shown without any mention of “main”, “extension", etc. When cavity fill is recommended the data collection includes whether there might

be issues of cavity less than 50 mm, high exposure or difficulties of access. If any of those apply an addendum is included on the EPC saying that the issues should be investigated to establish the best treatment for the walls.

Note 4. Controls are:
- for radiator systems, programmer, roomstat and TRVs (or time and temperature zone control if already present), interlocked system, separate timing of space and water heating (if regular boiler);
- for underfloor systems: time and temperature zone control.

Also:
- in the case of measure I, leave cylinder as it is (but with cylinderstat and improved insulation if applied earlier in the sequence)
- in the case of measures R, S and T, if regular boiler, cylinder of normal size (no solar panel) or medium size (solar panel present) with 50 mm factory-applied insulation and cylinderstat
- when there are two boilers, if main system 1 is being upgraded to a new boiler the new boiler does the water heating, unless main system 2 is also being upgraded to a new boiler (improvement I for both boilers) and the water heating was from main system 2 – in that case water heating stays with main system 2.

Note 5. Controls are programmer, roomstat and TRVs, interlocked system.

Note 6. If 80% or less of the windows are single glazed, a recommendation should be made for double glazing of all single-glazed windows. If the assessor cancels this recommendation, a recommendation is made for secondary glazing for the single-glazed windows. The secondary glazing option appears only in these circumstances.

Note 7. Solid wall insulation is considered for main wall, extensions 1, 2, 3 and 4 and alternative walls as applicable and applied to all applicable walls. Implemented by changing the wall insulation to solid wall insulation but leaving the building dimensions (in the reduced data set) the same. In the Energy Report the total figure for the measure is shown without any mention of "main", "extension", etc. This measure is not applied to system built walls or cob walls.

Note 8. Heating controls are programmer, room thermostat and TRVs. Water cylinder unchanged.

Note 9. Heating controls are programmer and room thermostat. Water cylinder is within the heat pump casing and replaces any existing one.

Note 10. Heating controls are programmer, room thermostat and TRVs. Water cylinder unchanged.

Heating upgrades

An improvement to a heating system by adoption of any of the following measures:

I, J, K, M, R, S, T

is taken as extending the main heating system to the whole dwelling where that is not the case in the existing dwelling. Thus when implementing any of the above measures, the number of heated habitable rooms is to be set equal to the number of habitable rooms. This rule affects the results where there are unheated habitable rooms and no identified secondary heater. If there is an identified secondary heater, the secondary heater remains throughout the sequence of calculations of improvement measures. Also, in the case of measure T upgrading storage heaters to a condensing gas boiler, if the secondary heating has been given as portable electric heaters the secondary heating becomes none after the upgrade.

In the case of measure T, if the existing heating is storage heaters or off-peak underfloor electric heating (401, 402, 404, 408, 421, 422) change the electric meter to single.

Heating upgrades when there are two main systems

In the case of measure I (upgrade boiler, CPSU or range cooker, same fuel) where both systems each use the same fuel, apply the improvement to both boilers as applicable (i.e. boiler is non-condensing) as a single step. If the result attains the SAP increase criterion make the recommendation on the EPC using the improvement text applicable to main system 1 if both boilers are being upgraded.

In the case of any other combination of main heating systems, apply the improvement to system 1 only. This includes measure I where that is relevant to main system 1 but not main system 2, as well as consideration of measures J, K, M, R, S and T .

Heating control upgrades when there are two main systems

Apply the improvement to the controls on system 1 only, except apply improved controls to both boilers if both replaced.