

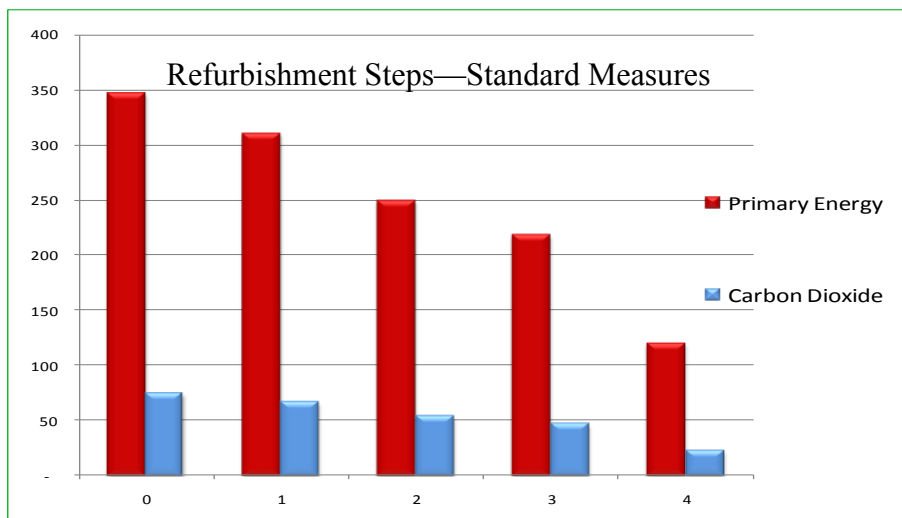


**Description:** Mid or end of terrace house commonly built in Dublin with a red-brick front with a small cavity behind it on the ground floor and 9 inch hollow block walls elsewhere. Insulation first appeared in 1978 and these walls would typically be drylined with 25mm polystyrene board or with 50mm of insulation fibre between battens.

Building elements :		Insulation	U - value
<b>Walls</b>	Concrete hollow block, drylined	15-25 mm	1.1
<b>Roofs</b>	Pitched, insulation between joists	100 mm	0.4
<b>Floors</b>	Solid	10-15 mm	0.57
<b>Windows</b>	Double glazed, metal frame, 6mm gap	n.a.	3.7
<b>Doors</b>	Double glazed, metal frame, 6mm gap (front) Solid wood (kitchen door)	n.a. none	3.7 3.0
Heating systems characteristics:		Fuel	Efficiency
<b>Primary</b>	Central heating boiler, pipework uninsulated.	Mains gas	70%
<b>Secondary</b>	Open fire in grate	Solid multi-fuel	30%
<b>Hot water</b>	From primary heating system. Electric immersion heater is used in summer.		
<b>Cylinder</b>	Insulated with loose jacket, 35 mm thick, no thermostat.		
<b>Controls</b>	Programmer.		

Refurbishment steps — standard				Prim. energy kWh/m <sup>2</sup> /y	Carbon Dioxide kgCO <sub>2</sub> /m <sup>2</sup> /y	Energy Rating	
0	Building fabric upgrade steps:			Expected U-values	<b>346</b> (actual state)	<b>74</b> (actual state)	<b>E2</b>
1	<b>Roof insulation and standard package*</b>	Add	200 mm mineral wool over the existing insulation.	0.13	310	66	E1
2	<b>Wall insulation</b>	Replace insulation	Walls re-drylined with 82.5mm phenolic/urethane boards.	0.27	249	53	D1
3	<b>Windows and Doors</b>	Replace	Double glazed low-e windows, air filled, 16mm gap Insulated doors.	2.0	218	46	C3
<b>Systems upgrade:</b>							
4	<b>Space and water heating system and controls</b>	Replace	Condensing boiler 90% efficient, two separated heating zones with time and thermostatic control, independent water heating. Hot water cylinder insulated with 50 mm spray foam.		<b>120</b>	<b>23</b>	<b>B2</b>

\*also includes draughtstripping, 80mm lagging jacket for DHW cylinder and low energy bulbs.



Primary Energy: kWh/m<sup>2</sup>/y, Carbon Dioxide emissions: kg/m<sup>2</sup>/y


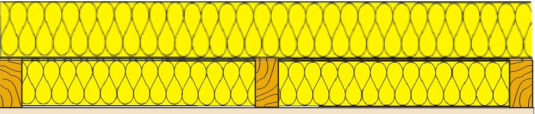
### Estimated costs and payback time\*\*

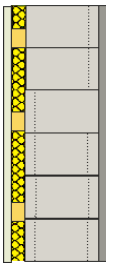
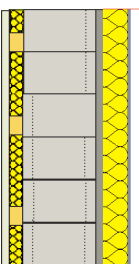
Measure	Estimated costs	Payback (y)
Step 1	€ 680	3.8
Step 2	€ 6,160	25.9
Step 3	€ 7,200	59.6
Step 4	€ 3,000	6.8
<b>Total:</b>	<b>€ 17,040</b>	<b>17.5</b>

### Standard upgrade summary

Consumption of primary energy reduced by:	<b>226 kWh/m<sup>2</sup>/y</b>
Emission of carbon dioxide reduced by:	<b>51 kgCO<sub>2</sub>/m<sup>2</sup>/y</b>

\*\*Note: 1. Costs are indicative only, based on typical prices (2011). 2. Measures analysed are one of many options, especially for the renewable heating systems.

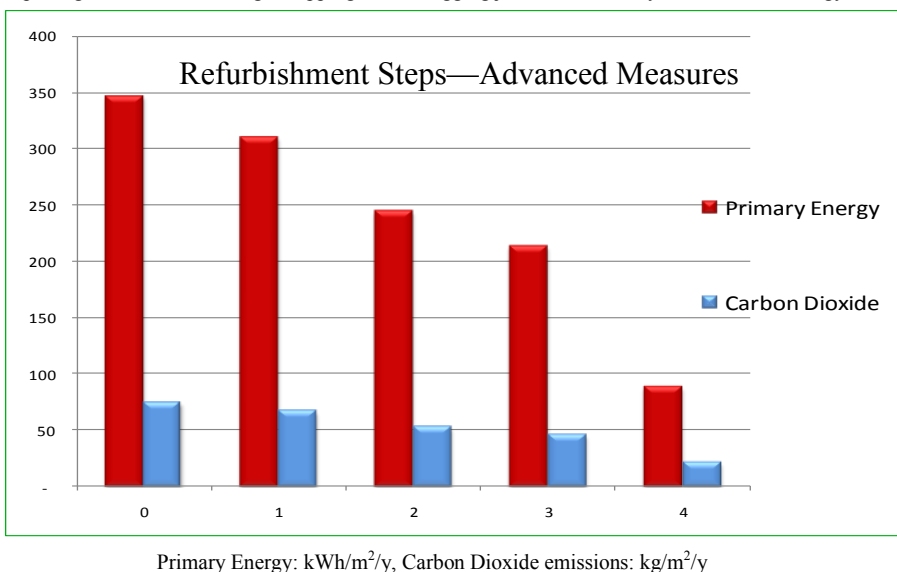
Typical roof upgrade (standard/advanced)	
100 mm of mineral wool between the ceiling joists	 <p>Before:</p>
Typical roof upgrade includes topping the attic insulation up to 300 mm. Conductivity = 0.04 W/mK	 <p>After:</p>

Typical wall upgrade (advanced)			
Before		After	
	Concrete hollow block walls, drylined insulation between the timber battens, U-value = 1.1 W/m <sup>2</sup> K		External wall insulation added, urethane, phenolic or EPS boards, thickness: 80-120mm, conductivity = 0.021—0.031 W/mK

Heating system upgrade		
Feature:	Standard	Advanced
<b>Heat generator</b>	Regular condensing boiler	Air source heat pump
<b>Efficiency:</b>	90%	380%
<b>Fuel:</b>	Mains gas	Electricity
<b>SH Controls type:</b>	Full zone control	Full zone control
<b>Hot water source (HW):</b>	Primary heating system	Primary heating system and solar thermal panels providing 50% of HW demand
<b>HW Cylinder:</b>	120 litre, factory insulated	200 litre combined cylinder, factory insulated
<b>HW Controls type:</b>	Time and thermostat	Time and thermostatic
<b>Ventilation:</b>	Natural	MVHR, 90% efficient

Refurbishment steps — advanced				Prim. energy kWh/m <sup>2</sup> /y	Carbon Dioxide kgCO <sub>2</sub> /m <sup>2</sup> /y	Energy Rating	
0	Building fabric upgrade steps:			Expected U-values	<b>346</b> (actual state)	<b>74</b> (actual state)	<b>E2</b>
1	<b>Roof insulation and standard package*</b>	Add	200 mm mineral wool over the existing insulation.	0.13	310	66	E1
2	<b>Wall insulation</b>	Add	Walls insulated externally with 80-120 mm thick insulation boards	0.21	244	52	D1
3	<b>Windows and Doors</b>	Replace	Triple glazed low-e windows, argon filled, 16mm gap PVC/wooden doors, insulated	1.3 2.0	213	45	C3
<b>Systems upgrade:</b>							
4	<b>Space and water heating system and controls</b>	Replace	Air source heat pump 380% efficient, two separated heating zones with time and thermostatic control, independent water heating, solar thermal panels providing 50% of hot water demand with combined HW cylinder. Mechanical ventilation with heat recovery (MVHR).		<b>88</b>	<b>21</b>	<b>B1</b>

\* package also includes draughtstripping, 80mm lagging jacket for DHW cylinder and low energy bulbs.



### Estimated costs and payback time\*\*

Measure	Estimated costs	Payback (y)
Step 1	€ 680	3.8
Step 2	€ 8,260	32.3
Step 3	€ 9,350	76.9
Step 4	€ 11,100	26.5
<b>Total:</b>	<b>€ 29,390</b>	<b>30.2</b>

### Advanced upgrade summary

Consumption of primary energy reduced by:	<b>258 kWh/m<sup>2</sup>/y</b>
Emission of carbon dioxide reduced by:	<b>53 kgCO<sub>2</sub>/m<sup>2</sup>/y</b>

\*\*Note: 1. Costs are indicative only, based on typical prices (2011). 2. Measures analysed are one of many options, especially for the renewable heating systems.

Analysis conducted in association with IHER Energy Services, [www.iher.ie](http://www.iher.ie)