



Building elements :		Insulation	U - value
<b>Walls</b>	300 mm cavity walls, partially filled	15-25 mm	1.1
<b>Roofs</b>	Pitched, insulation between joists	100 mm	0.4
<b>Floors</b>	Solid	10-15 mm	0.64
<b>Windows</b>	Double glazed, metal frame, 6mm gap	n.a.	3.7
<b>Doors</b>	Double glazed, metal frame, 6mm gap	none	3.0

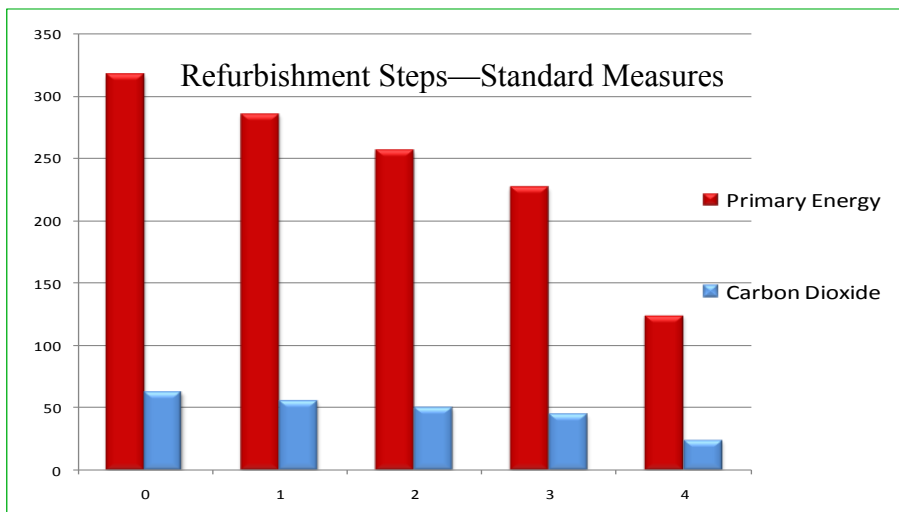
Heating systems characteristics:		Fuel	Efficiency
<b>Primary</b>	Central heating boiler, pipework uninsulated.	Mains gas	70%
<b>Secondary</b>	Gas fire, coal effect	Mains gas	20%
<b>Hot water</b>	From primary heating system. Electric immersion heater is used in summer.		
<b>Cylinder</b>	Insulated with loose jacket, 35 mm thick, no thermostat		
<b>Controls</b>	Time clock only		

## Description

Terraced house with cavity walls containing 25mm insulation boards. This one was found in Dublin but it could be anywhere in Ireland. This house is a perfect candidate for cavity wall insulation. Solid floors were standard for this period and so floor insulation options are limited.

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>318</b> (actual state)	<b>62</b> (actual state)	<b>E1</b>
1	<b>Roof insulation and standard package*</b>	Add	200 mm mineral wool over the existing insulation.	0.13	286	55	D2
2	<b>Wall insulation</b>	Add	50-80 mm of remaining cavity filled with beads	0.41 (for 50mm)	257	50	D1
3	<b>Windows and Doors</b>	Replace	Double glazed low-e windows, air filled, 16mm gap, Insulated doors	2.0	227	44	D1
Systems upgrade:							
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>124</b>	<b>24</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


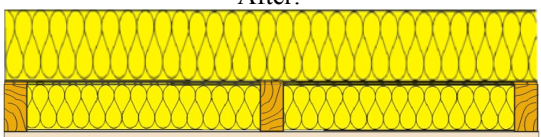
## Estimated costs and payback time\*\*

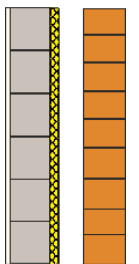
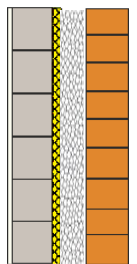
Measure	Estimated costs	Payback (y)
Step 1	€ 620	3.8
Step 2	€ 460	3.9
Step 3	€ 5,850	18.3
Step 4	€ 3,000	11.4
<b>Total:</b>	<b>€ 9,930</b>	<b>11.5</b>

## Standard upgrade summary

Consumption of primary energy reduced by:	<b>194 kWh/m<sup>2</sup>/y</b>
Emission of carbon dioxide reduced by:	<b>38 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.

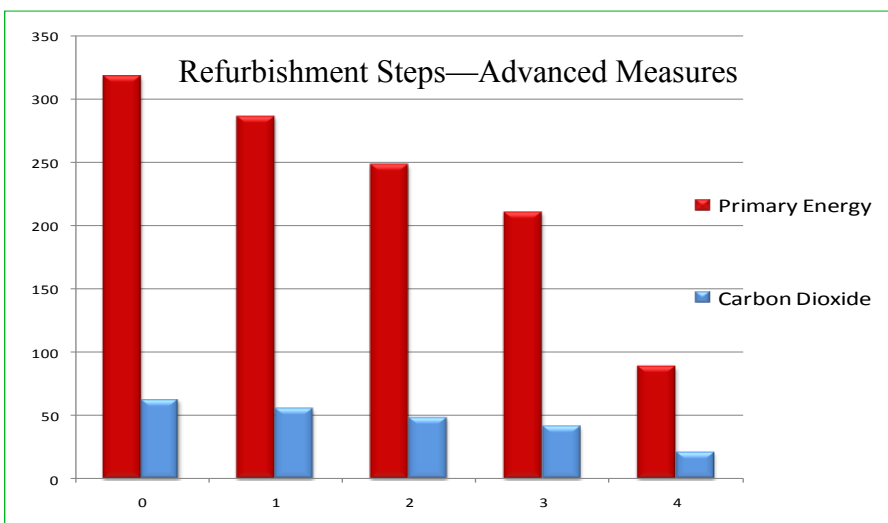
Typical roof upgrade (standard/advanced)	
100 mm of mineral wool between the ceiling joists	<p>Before:</p> 
Typical roof upgrade includes topping the attic insulation up to 300 mm. Conductivity = 0.04 W/mK	<p>After:</p> 

Typical wall upgrade (standard)	
Before	After
 <p>Cavity walls, outer brick and inner block with plasterwork, partially insulated U-value = 1.1 W/m<sup>2</sup>K</p>	 <p>Remaining cavity filled with the beads through the number of holes drilled in the outer brickwork. Conductivity of beads up to 0.033 W/mK</p>

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, load compensation
<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 thermostatic	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>318</b> (actual state)	<b>62</b> (actual state)	<b>E1</b>
1	<b>Roof insulation and standard package*</b>	Add	200 mm mineral wool over the existing insulation.	0.13	286	55	D2	
2	<b>Wall insulation</b>	Add	50-80 mm of remaining cavity filled with beads, with combination of drylining (front) and external wall insulation (rear). Thickness: 50-100 mm	0.21	248	48	D1	
3	<b>Windows and Doors</b>	Replace	Triple glazed low-e windows and doors, argon filled, 16mm gap.	1.3	210	41	C3	
Systems upgrade:								
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>89</b>	<b>21</b>	<b>B1</b>	

\* package 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	€ 620	3.8
Step 2	€ 4,720	31.2
Step 3	€ 8,100	54.1
Step 4	€ 11,100	27.0
<b>Total:</b>	<b>€ 24,540</b>	<b>28.1</b>

### Advanced upgrade summary

Consumption of primary energy reduced by:	<b>229 kWh/m<sup>2</sup>/y</b>
Emission of carbon dioxide reduced by:	<b>41 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