



Building elements :		Insulation	U - value
<b>Walls</b>	Cavity walls, partially filled	50 mm	0.55
<b>Roofs</b>	Pitched, insulation between joists	150 mm	0.41
<b>Floors</b>	Solid	20-30mm	0.26
<b>Windows</b>	Double glazed, PVC/wood, 12 mm gap	n.a	2.8
<b>Doors</b>	Solid wooden	none	3

Heating systems characteristics:		Fuel	Efficiency
<b>Primary</b>	Central heating boiler, pipework uninsulated.	Heating oil	75%
<b>Secondary</b>	Open fire in grate	Smokeless	30%
<b>Hot water</b>	From primary heating system. Separated time controls,.		
<b>Cylinder</b>	Insulated with loose jacket, 50 mm, no cylinder thermostat		
<b>Controls</b>	Programmer for space heating and hot water, room thermostat.		

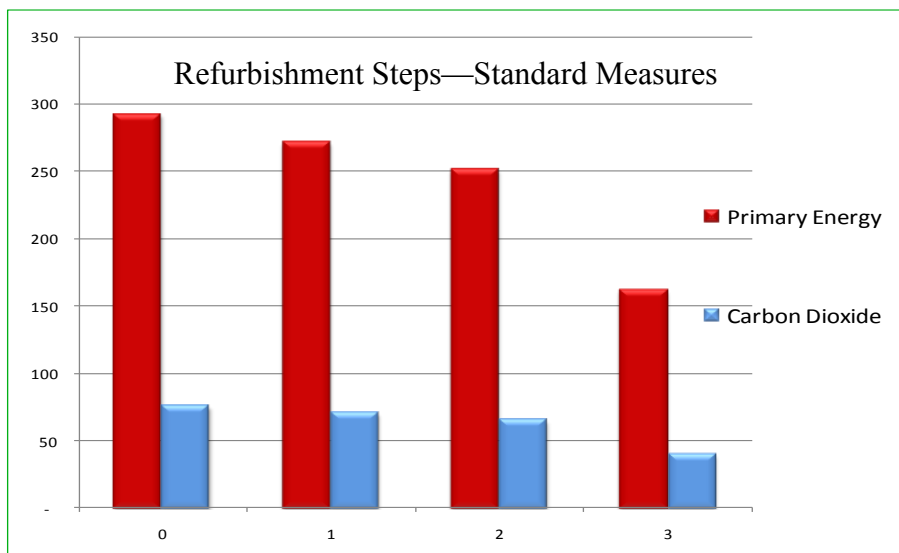
## Description

Semi-detached bungalow with cavity walls part-filled with 50mm polystyrene insulation boards. The part-filled cavity can be full-filled by pumping in additional insulation beads. The solid floor was insulated at the time of construction.

## Refurbishment steps — standard

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:			<b>292</b> (actual state)	<b>75</b> (actual state)	<b>D2</b>
1	<b>Roof insulation and standard package*</b>	Add	150 mm of mineral wool over the existing insulation	271	70	D2
2	<b>Wall insulation</b>	Add	Remaining cavity filled with insulation beads.	251	65	D1
Systems upgrade:						
3	<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>162</b>	<b>40</b>	<b>C1</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


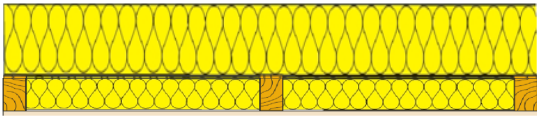
## Estimated costs and payback time\*\*

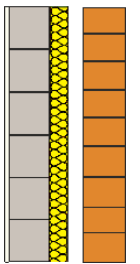
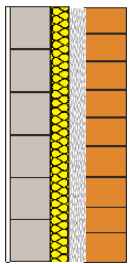
Measure	Estimated costs	Payback (y)
Step 1	€ 1,030	8.5
Step 2	€ 800	6.0
Step 2	€ 3,500	5.9
<b>Total:</b>	<b>€ 5,330</b>	<b>6.3</b>

## Standard upgrade summary

Consumption of primary energy reduced by:	<b>130 kWh/m<sup>2</sup>/y</b>
Emission of carbon dioxide reduced by:	<b>35 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.

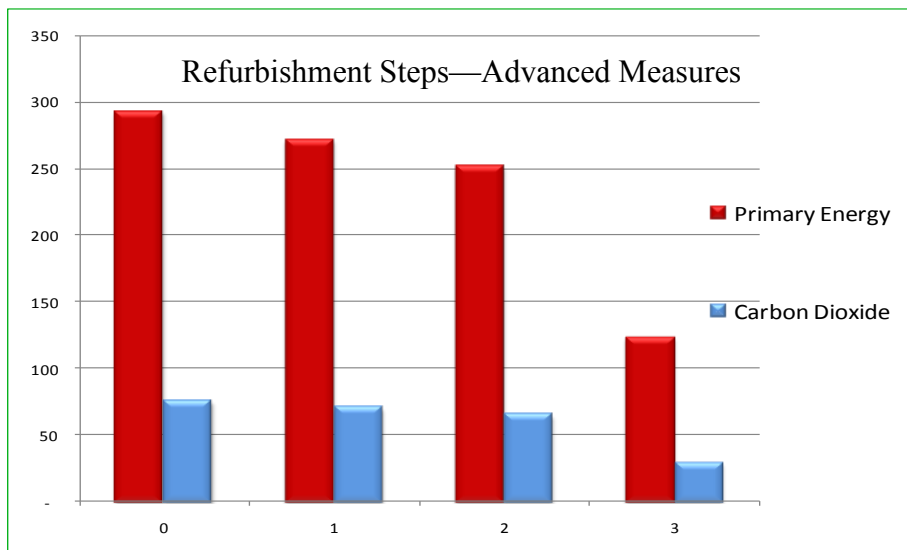
Typical roof upgrade (standard/advanced)	
150 mm of mineral wool between ceiling joists	<p>Before:</p> 
Typical roof upgrade includes topping the attic insulation up to 300 mm. Conductivity = 0.04 W/mK	<p>After:</p> 

Typical wall upgrade (advanced)			
Before		After	
	Cavity walls, partially filled with insulation boards, 50 mm thick. U-value = 0.55 W/m <sup>2</sup> K		Remaining cavity filled with insulation beads, conductivity = 0.033 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>	Heating oil	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>292</b> (actual state)	<b>75</b> (actual state)	<b>D2</b>
1	<b>Roof insulation and standard package*</b>	Add	150 mm of mineral wool over the existing insulation.	0.13	271	70	D2
2	<b>Wall insulation</b>	Add	Remaining cavity filled with insulation beads.	0.32	251	65	D1
Systems upgrade:							
2	<b>Space and water heating system and controls</b>	Replace	Air source heat pump 380% 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>124</b>	<b>29</b>	<b>B2</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	€ 1,030	8.5
Step 2	€ 800	6.0
Step 3	€ 11,100	11.2
<b>Total:</b>	<b>€ 12,930</b>	<b>10.4</b>

### Advanced upgrade summary

Consumption of primary energy reduced by:	<b>168 kWh/m<sup>2</sup>/y</b>
Emission of carbon dioxide reduced by:	<b>46 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