mesh
the smart renewable energy consultancy

Insulation carbon analysis

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Contents

Introduction

This report will investigate the performance of the existing house against the improved house. The study will show the benefits against reduction in energy consumption and carbon emissions.

Brief Development Overview

This Energy Strategy Statement seeks to compare the current house against the improved version. The current house is located within the London Borough of Camden and situated within the Jeffrey's Street Conservation Area. Due to the standards set by the council on the refurbishment of the property, careful consideration has been taken into making sure that the improvements don't hinder tamper with the historic elements of the house.

Scenario	Annual energy consumption kWh	Annual carbon emission kgCo2	Insulation embodied carbon, kgCO2
Current House	33,375	6,800	N/A
House insulated with organic material (mineral wool)	19,427	4,080	252
House insulated with polyurethane (PIR)	19,076	3,950	856

As seen in the table above, insulating the house with organic material will save 40% of annual energy and carbon in comparison with current state, while insulating it with conventional PIR will allow savings of 41% and carbon.

Organic materials will have a lower impact in relation to the embedded carbon of the insulation materials. This savings is equal to 3.5 years of insulating with PIR.

Executive Summary

Legislation and limiting u-values for existing buildings.

Part O of the building regulations specifies in Table 4.3 the limiting U-values for existing elements in existing buildings refer to the maximum thermal transmittance (U-value) that is allowed for insulation upgrades or improvements in existing buildings. These U-values are set as standards to ensure that energy efficiency improvements are made when renovating or retrofitting existing structures.

The following table shows the Limiting u-values for existing walls in existing buildings as established by building regulations, and in comparison, to the proposed 75mm insulation parameters.

Element Name	Part L limiting threshold	Part L recommended for improved elements	Current conditions	Mineral wool	PIR
External walls, u-value	0.70	0.30	2.12	0.40	0.30

The table above demonstrate that adding 75mm of insulation helps reducing the material u-value beyond the limiting threshold as established by the national building regulations. Part L also states that if meeting the standard (improved) reduce the internal floor area of the room by the wall significantly, a lesser standard may be appropriate. While this is not the case for PIR, it does affect using mineral wool as insulation.

Mesh recommends using 75mm of mineral wool as insulation, as this material goes way beyond the threshold factor. As a result, the total carbon savings of both elements are almost equal. Moreover, the Mineral wool material has a lower embodied carbon in comparison with PIR, as well as other construction benefits in relation to fire resistance and moisture control.

It is important to note that listed building do not need to follow Part L values, but it is considered the minimum standard for improvement of buildings in terms of energy and carbon efficiency.

Context

Each scenario has been assessed using the U – Vaues of each element and area occupied by the element. In this study, the elements considered are:

- External walls
- Door
- Roof
- External Windows
- Rooflights
- Ground floor
- Insulated External wall.
    - Wall area 1 (scenario 1) – The Lower ground floor walls insulated only.
    - Wall area 2 (scenario 2) - The Lower ground floor, ground floor rear wall and Second floor walls are insulated.

Building U values

The current U-Values of the house are determined by considering the building's age, while the subsequent U-Values are calculated by considering the thermal conductivity of the insulation, the element's area, and its type. The Glazing has been also improved by adding secondary glazing internally.

Element Name	Current House U Value	Mineral Wool Insulated Building U value	PIR Insulated building U Value
External walls	2.12	2.12	2.12
Door	1.50	1.50	1.50
Roof	2.00	2.00	2.00
Rooflights	5.70	5.70	5.70
Ground floor	1.50	1.50	1.50
External Windows	5.70	1.40	1.40
Insulated External wall	2.12	0.40	0.30

Objective of the Calculation

The study aims to show the importance and significance of installing the internal wall insulation in the designated places in the property as well as improving the glazing by adding a secondary internal glazing. The study concludes using the annual energy consumption and carbon emissions as the measure of comparison.

Energy and Carbon Emissions

Energy Consumption comparison

When we evaluate the energy consumption of the current house and compare it to the energy consumption when considering improving the external glazing and varying insulation options such as mineral wool and PIR, we observe a similar reduction in energy usage. Specifically, mineral wool achieves a 40% reduction, while PIR insulation results in an 41% decrease in energy consumption.

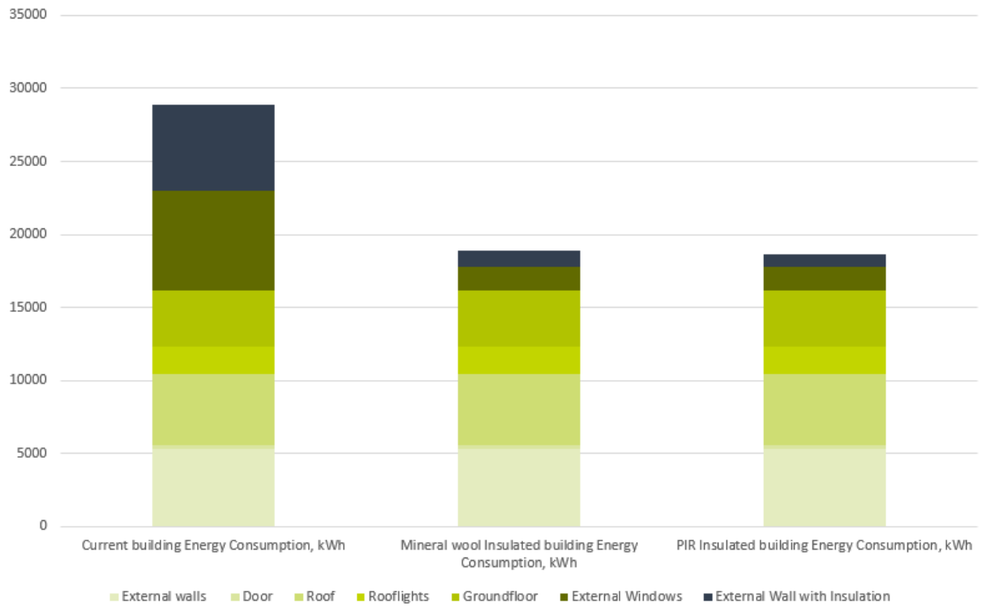

Figure 1 Annual Energy Consumption

Carbon Emissions comparison

When we assess the carbon emissions of the existing house and contrast them with the emissions associated with insulation choices like mineral wool and PIR, we find a consistent trend in reduced environmental impact. Specifically, mineral wool leads to a 40% reduction, while PIR insulation results in a 42% decrease in annual carbon emissions.

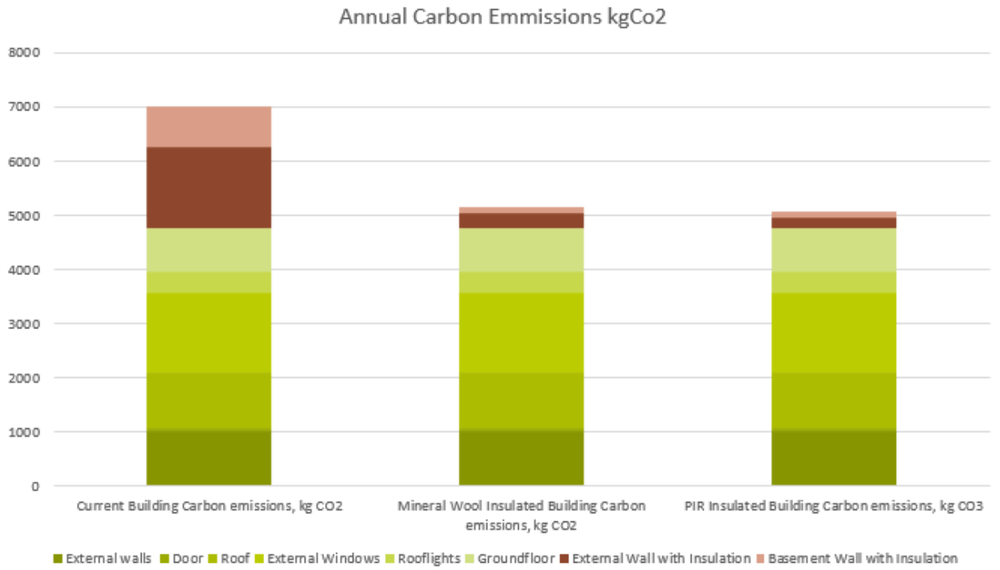

Figure 2 Annual Carbon Emissions

Scenario based comparison.

We have analysed three different scenarios based on the area of insulation added.

- Scenario 1, we focused on adding 75mm of mineral wool insulation exclusively to the basement.
- Scenario 2 involved applying the same insulation to the basement as well as the rear wall of the ground floor and all external walls of the second floor.

Scenario 1 made a substantial 28% reduction of energy and CO2 in comparison to the current scenario. Nevertheless, scenario 2 resulted in an additional 13% annual reduction in energy consumption compared to scenario 1 and a substantial 41% reduction when compared to the current state of the house. This clearly demonstrates that improving the house fabric to the conditions of scenario 2 significantly enhances the home's efficiency and environmental friendliness.

Therefore, Mesh recommends adding insulation to all the selected external wall.

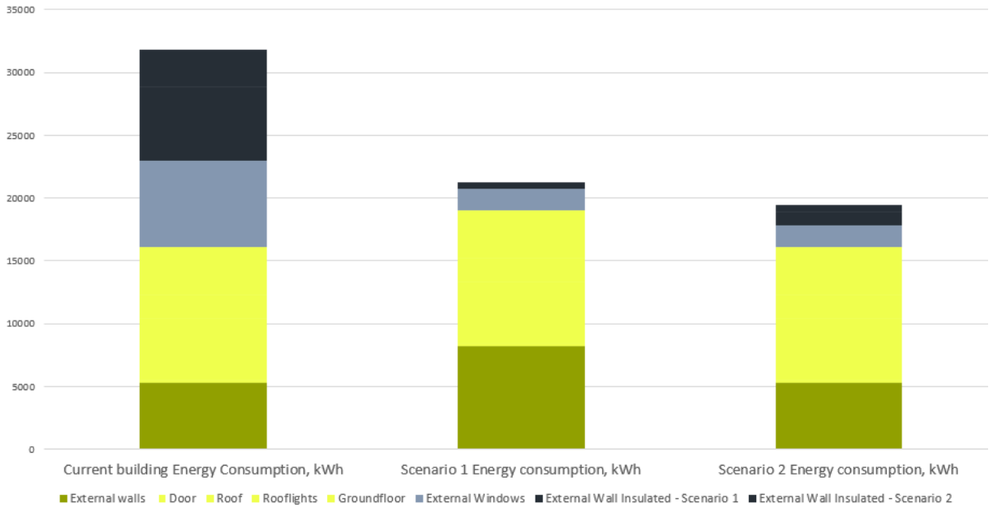

Figure 3 Scenario based comparison.

Insulation Material details

The details of the insulation considered for this study in the external wall is as shown below:

Material type	Cost of Element £	Thermal Conductivity W/mK	Embodied carbon kgCo2e	Payback Period Years
PIR rigid insulation	870	0.25	1040.4	1.7
Mineral wool	262	0.33	306.0	0.5

Conclusion

In conclusion, the implementation of insulation in the project has proven to be a highly effective and environmentally responsible choice. Not only has it led to a significant reduction in annual energy consumption for the house, but it has also contributed to a notable decrease in carbon emissions.

Scenario	Annual energy consumption kWh	Annual carbon emission kgCo2	Insulation embodied carbon, kgCO2
Current House	33,375	6,800	N/A
House insulated with organic material (mineral wool)	19,427	4,080	252
House insulated with polyurethane (PIR)	19,076	3,950	856

The annual energy consumption would substantially reduce as seen above in comparison to the current house and would increase comfort level of living to the house.

This outcome underscores the importance of reinforcing the building with insulation as a key component in reducing both energy consumption and environmental impact.

In this case it is recommended to consider mineral wool insulation for the improvement of the building's performance.

Mineral wool is a natural material-based insulation type which has a low embodied carbon making its impact low on the environment, while substantially reducing the energy demands of the house within the permissible application. It improves performance and carbon impact of the house by 40%.

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Appendix - From BFO calculations

Current house

Element Name	**Element Area, m²**	Current building u-values	Current building Energy Consumption, kWh
External walls	60.84	2.12	5302
Door	3.9	1.50	240
Roof	59.7	2.00	4908
Rooflights	8	5.70	1874
Groundfloor	61.7	5.70	3804
External Windows	29.4	1.50	6888
External Wall with Insulation	67.141	2.12	5851
Infiltration	10		32,493.00

Mineral wool Insulated house

Element Name	Element Area, m²	Mineral Wool insulated Building U-value (W/m2.K)	Mineral wool Insulated building Energy Consumption, kWh
External walls	60.84	2.12	5302
Door	3.9	1.50	240
Roof	59.7	2.00	4908
Rooflights	8	5.70	1874
Groundfloor	61.7	1.50	3804
External Windows	29.4	1.40	1692
External Wall with Insulation	67.141	0.39	1076
Infiltration	10		19,427.02

PIR Insulated House

Element Name	Element Area, m²	PIR insulated Building U-value (W/m2.K)	PIR Insulated building Energy Consumption, kWh
External walls	60.84	2.12	5302
Door	3.9	1.50	240
Roof	59.7	2.00	4908
Rooflights	8	5.70	1874
Groundfloor	61.7	1.50	3804
External Windows	29.4	1.40	1692
External Wall with Insulation	67.141	0.30	828
Infiltration	10		19,076.04

Insulation details

Material type	Thickness (mm)	Design U-value (W/m2.K)	w/k	kWh/yr	Annual Fuel Cost	Annual saving	Cost of element	Embodied carbon, kgCo2e
PIR rigid insulation	75	0.3	24	1006	£ 103	£ 624	£ 1,057.84	1040.4
Mineral wool	75	0.39	32	1308	£ 134	£ 593	£ 318.42	306.0

Building U values

Element Name	Current House U Value	Mineral Wool Insulated building U value	PIR Insulated building U Value
External walls	2.12	2.12	2.12
Door	1.50	1.50	1.50
Roof	2.00	2.00	2.00
Rooflights	5.70	5.70	5.70
Groundfloor	1.50	1.50	1.50
External Windows	5.70	1.40	1.40
External Wall with Insulation	2.12	0.39	0.30

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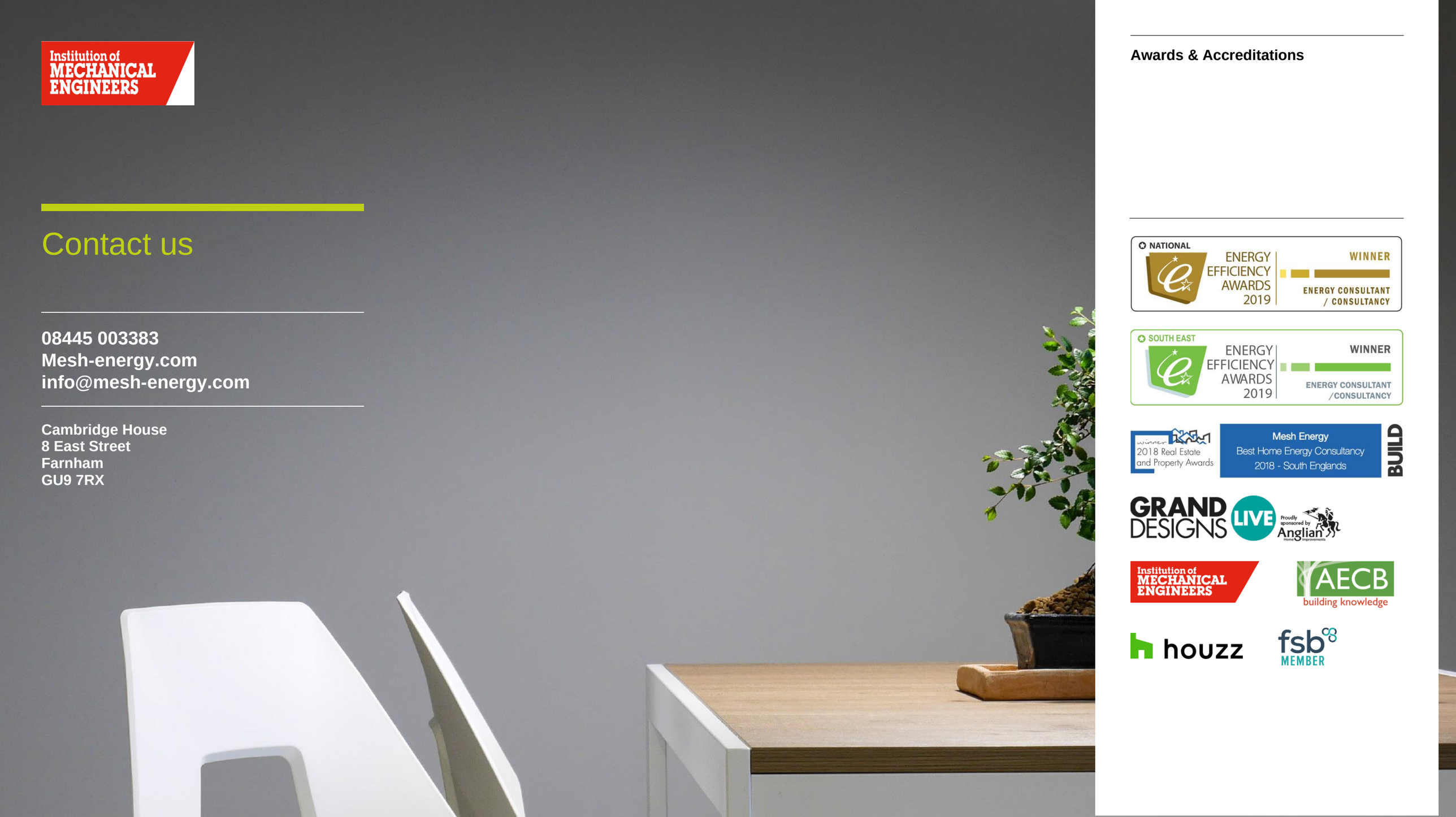

Awards & Accreditations

NATIONAL ENERGY EFFICIENCY AWARDS 2019 — WINNER — ENERGY CONSULTANT / CONSULTANCY

SOUTH EAST ENERGY EFFICIENCY AWARDS 2019 — WINNER — ENERGY CONSULTANT /CONSULTANCY

2018 Real Estate and Property Awards — Mesh Energy — Best Home Energy Consultancy 2018 - South Englands — BUILD

GRAND DESIGNS LIVE — Proudly sponsored by Anglian Home Improvements

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