

Low Carbon Retrofitting of 1981 Semi- Detached House

Deepak Yandamuri

University of Wales trinity saint david, Msc Sustainable Construction

Abstract

This research poster examines the energy efficiency and retrofit potential of a 1981 semi-detached house. Retrofit strategies include insulating internal walls, replacing the old gas boiler with an energy-efficient one, and installing solar photovoltaic panels. Considerations include the interaction of retrofit measures and cost implications. Future directions involve exploring triple glazing, roof insulation, and alternative heating options. The research emphasizes property inspections and addressing air leaks, inefficient appliances, and leaks in valves, pipes, and radiators. Insights aim to improve energy efficiency within financial limitations and social value principles.

Introduction

This research poster presents an analysis of a 1981 semi-detached house, focusing on its energy efficiency characteristics and retrofit potential. The house features a construction design that includes a beam and block suspended floor with a 60mm screed, 35mm render, 102 brick/block layers, an uninsulated 80mm cavity, and a 100mm thermalite block. The partition wall to the adjoining property is constructed with a 102mm brick cavity wall, lacking insulation. The roof follows a cold roof construction with concrete tiles, felt, and trussed rafters at 600mm centers. Ventilation is provided through eaves and apex tile vents, with approximately 25mm of blown insulation on the ceiling. The windows are uPVC double-glazed but lack trickle vents. With an EPC rating of F, the house demonstrates lower energy efficiency. The heating system comprises a gas boiler, gas central heating, a hot water cylinder, and a gas fire. This research aims to evaluate the overall energy efficiency of the 1981 semi-detached house and identify retrofit opportunities. By assessing the construction elements, insulation levels, and heating systems, the study will provide insights for improving energy performance, reducing carbon emissions, and creating sustainable housing solutions for similar homes.

Optimum Retrofit options

- 1) Party wall & cavity wall Insulation:** Jason Palmer et al research shows that insulating the party wall, can only save up to 0.8% of gas energy, So **retrofitting the part wall of dwelling is avoided in this study**[1]. Guangying Ren et al simulation study shows that insulating wall with extruded polystyrene layer with air cavity can decrease thermal conductive at least half times. Therefore, insulating internal wall is cost effective and thermal efficiency retrofit option[2].
- 2) Boiler Replacement:** After solid insulation, Installing New Energy efficient A-Rated Gas Boilers is the viable solution. Original Boilers installed in the house is more than 15 years so efficiency is reduced to less than 60%. According to Bizzarri, Installing New boiler can achieve more than 90% efficiency [3]. Minimal disturbance to neighbors during retrofitting the boilers.
- 3) Solar Photovoltaics:** Installation of solar panels on the top of the roof is the third solution proposed in this study. Studies shows that solar PV cells installation sows overall positive impact in long term of 30 years. This statement is backed by Salem R Life-cycle analysis study as shown in graph 1 [8]. Simple pay back period is between 10 to 15 years based on usage. Life cycle analysis shows that positive net savings after 15 years.

Discussion on Energy rating

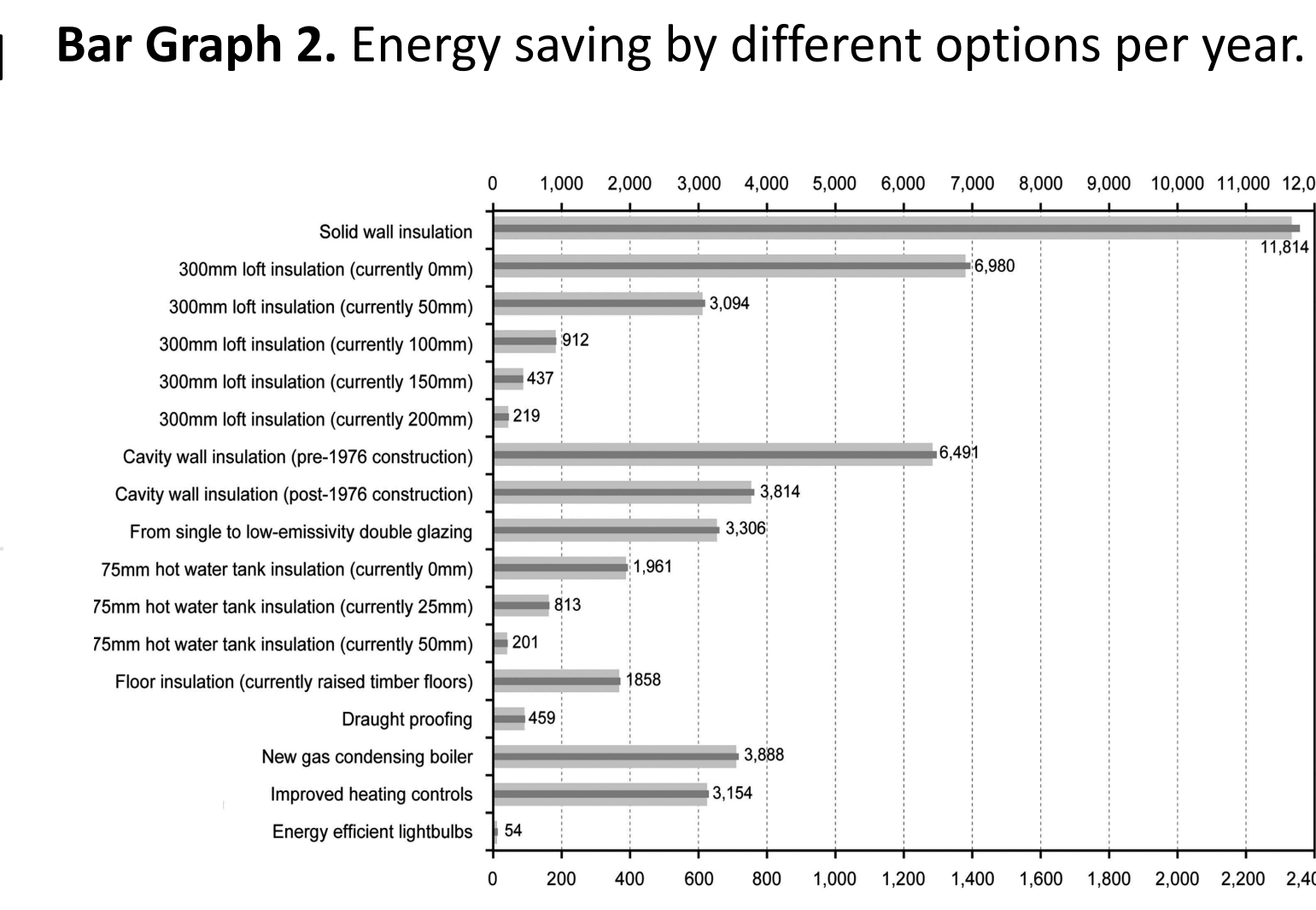
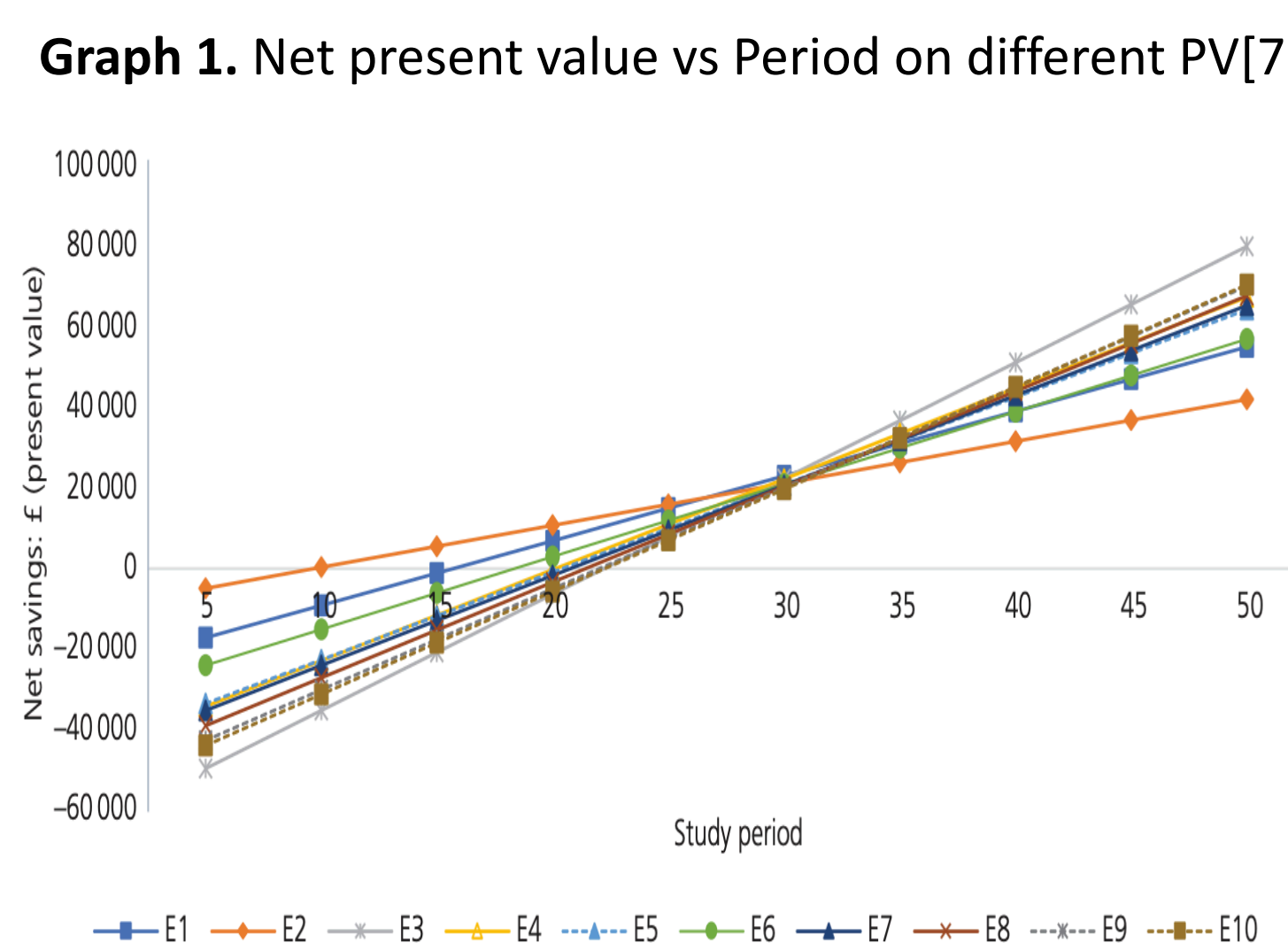
With all the given upgrading solutions house rating can be improved to from F rating but achieving A rating need further enhancements such as adding effective heat exchangers, hot water storage tanks, adding trickle vents, replacing energy saving washing machines and many more, which costs fortune for the owner. Property is installed with gas central heating it doesn't makes sense to replace everything. It is assumed that owner should strategize and do a phase based renovations to make home energy efficient overtime. Initial objective of the should be reduction of internal thermal loads and monitoring the system with upgrading to smart meters.

Challenges and Discussion

- The reason for selecting these retrofit options over many other options is due to less interdependent measures and these does not interact with other options ;reference PAS 2035: 2019(The measures interaction matrix) [5]. According to the matrix, Installing new boiler can eliminates Boiler repair ,New central heating, system Electric storage heater replacement and Electric storage heater. A typical 35KW boiler cost ranges from £1500 to £2000, Initially this can be a burden on the owner but can save up to 30% of energy annually [6].Most researches calculated payback period considering pre pandemic and pre Russia-Ukraine conflict, so literal face values are not considered in the study.
- Solar photovoltaics measures is almost independent on all the retrofits according to the PAS 2035:2019 manual. Government of UK encourages households to install solar cells. PV cells seems to be tempting solution but UK unpredictable climatic conditions makes difficult to project accurate energy production data. As per green match it costs 400 £ – 500 £ per 250 watt panel, so for this house it is roughly estimated 1500 £– 2500 £ to operate lights, exhausts and charging ports [8].
- Retrofitting options are carefully considered so that heritage value of the building is not decremented. Although, while insulating the walls there can be considerable disturbances to neighbors. Graph 2 shows that insulating cavity wall can drastically increase the energy efficiency.



Figure 1: 1981 Semi-Detached house



Conclusions

- Optimum retrofit options for the 1981 semi-detached house include insulating internal walls, replacing the boiler with an energy-efficient model, installing solar photovoltaics, and addressing air leaks and inefficient appliances.
- Achieving an A rating from the current F rating requires phased renovations and strategies such as smart metering and exploring triple glazing and roof insulation options.
- Implementing these retrofit measures will significantly improve the energy efficiency, reduce carbon emissions, and create a more sustainable and comfortable living environment in the 1981 semi-detached house.

Future Directions

- In future it is recommended to explore, Triple gazing of windows and Insulating the roof options.
- Other reliable heating options should be considered such as geothermal heat pumps and Thermal Solar collectors due to uncertainty natural gas tariff.
- In detail inspection of property: Check air leaks, eliminate inefficient electric appliances, Check leaks in valves, pipes and radiators.

Contact Information

Deepak Yandamuri
Student ID: 2209422
UWTSd
Email: 2209422@student.uwtsd.ac.uk

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Acknowledgements

This research poster is study is conducted based on given specifications, so it is only for educational purpose cannot be directly implemented on any dwellings or property.