



Embodied Carbon Calculations for Heating Concepts in Irish Detached House



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INTRODUCTION

By 2050, around 50% of Ireland's houses will require substantial MEP renovations. In the midst of the current energy crisis, it is important to evaluate multiple renovation scenarios to determine which will be the most sustainable option in the long term. Three common renovations are identified: Deep-Retrofit Heat Pump, Deep-Retrofit Condensing Gas Boiler, and Shallow Retrofit Condensing Gas Boiler.



Revit Model of Detached House

OBJECTIVE

This research seeks to evaluate the efficacy of three renovation options for a traditional detached house archetype: Deep-Retrofit Heat Pump, Deep-Retrofit Condensing Gas Boiler, and Shallow-Retrofit Condensing Gas Boiler.

KEY ASSUMPTIONS

- 220 sq. m detached house
- 13 radiators in the building, all the same size and capacity
- 2% of total floor area impacted during renovations for piping install

METHODOLOGY

- Data Collection
- Life Cycle Analysis using WLC Assessment Tool for three scenarios
- Comparison and analysis of WLC Assessment Tool Results

RESULTS

The deep-retrofit heat pump renovation produces 35,619 kg of embodied carbon, the deep-retrofit condensing gas boiler produces 28,699 kg of embodied carbon, and the shallow-retrofit condensing gas boiler produces 27,373 kg of embodied carbon. All parameters were held constant throughout the evaluation process except for the heating apparatus used (heat pump or boiler), the piping associated with each apparatus (copper or PVC, respectively), and the inclusion of a Mechanical Heat Recovery System for deep-retrofit.

ANALYSIS

There is more carbon produced throughout the lifecycle of a Deep Retrofit Heat Pump installation vs. a Deep or Shallow Retrofit Boiler installation. With all parameters held the same except for the heating method and piping material associated with each heating method, results from the WLC tool suggest that there is overall less embodied carbon associated with a condensing gas boiler renovation vs. a heat pump renovation.



Results from WLC Assessment Tool

CONCLUSION

The findings of this study suggest that a deep-retrofit condensing gas boiler is a more viable and sustainable option for building renovations compared to a deep-retrofit heat pump renovation. In terms of deep and shallow-retrofit gas boilers, the deep retrofit is likely the better option. Despite slightly lower embodied carbon associated with a shallow retrofit, deep retrofits offer a more holistic approach to the renovation process, resulting in greater energy savings and increased longevity. This research is preliminary and acts under many assumptions that are not applicable to in-field work. More research is needed to determine the impact of these renovation types before a final suggestion is made.

RELATED LITERATURE

Barrett, S. (n.d.). WLC Tables Based Assessment. Retrieved 2023.

Government of Ireland Department of Environment, Climate, and Communications. (n.d.). National Retrofit Plan. www.gov.ie. Retrieved April 25, 2023, from <https://www.gov.ie/pdf/?file=https%3A%2F%2Fassets.gov.ie%2F15252%2Fa53faf62-c2ec-44d3-9cff-b61715a6d79f.pdf#page=null>