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Evaluating Energy Savings and Retrofit Strategies in Ireland's Warmer Homes Scheme

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EXTENDED ABSTRACT

Introduction / background

Ireland's residential sector is central to achieving national energy efficiency and decarbonisation targets, given the high share of energy consumption devoted to household heating[1]. The Sustainable Energy Authority of Ireland's (SEAI) Warmer Homes Scheme (WHS) supports this effort by providing fully-funded retrofits to low-income households, addressing fuel poverty while promoting energy and carbon savings. Past evaluations have often relied on average outcomes across all homes, which can obscure the diversity of retrofit approaches.

To improve the precision of WHS impact assessment, this study uses granular, dwelling-level Energy Performance Certificate (EPC) data for homes retrofitted in 2024. By analysing detailed pre- and post-retrofit conditions, the study estimates modelled energy and carbon savings more accurately. Clustering analysis is applied to measure installation patterns to identify common retrofit strategies. This enables a clearer understanding of how different combinations of measures influence modelled outcomes and costs, beyond what is captured by individual building characteristics.

Methodology

The analysis focused on homes upgraded in 2024, a year in which a high proportion of dwellings had both pre- and post-retrofit EPCs available. Data on energy performance and household retrofits were gathered from Irish EPCs and WHS grant programme databases. These two repositories were then merged, allowing for a comprehensive, single dataset that encapsulated each household's energy status before and after retrofitting. Following cleaning and filtering to retain only homes with complete pre- and post-retrofit data, the resulting sample size was 6,853 dwellings.

A comparison of pre- and post-retrofit modelled delivered energy consumption was carried out to quantify the extent of energy and carbon savings attributable to the programme. Savings values were then calibrated to account for the likelihood of rebound effects using a 33% realisation factor from a study by Coyne, Lyons, and McCoy[2] of metered energy savings from a sample of retrofitted social housing dwellings in Ireland. Fuel types were compared before and after retrofit to identify switching behaviour.

Binary indicators were created for each installed measure to allow for clustering analysis of the dwellings. K-Means clustering was then applied to the binary measure indicators to identify common retrofit strategies. Two regression models were then developed to assess whether differences in energy savings and projects costs

[1] Sustainable Energy Authority of Ireland (SEAI). 2022. "Heating and Cooling in Ireland Today: Archetype Profiles, Spatial Analysis, and Energy Efficiency Potential." https://www.seai.ie/sites/default/files/publications/Heating-and-Cooling-in-Ireland-Today.pdf.

[2] Bryan Coyne, Sean Lyons, and Daire McCoy. 2018. "The Effects of Home Energy Efficiency Upgrades on Social Housing Tenants: Evidence From Ireland." Energy Efficiency 11 (8): 2077–2100. https://doi.org/10.1007/s12053-018-9688-7.

across retrofit strategies reflect more than underlying dwelling characteristics. Both models included cluster membership as a categorical independent variable, alongside controls for pre-retrofit EPC rating, dwelling type, floor area, fuel type, and year of construction.

Results

The median modelled savings were 3,067 kWh per home per year and 1.07 tonnes of CO_2 per home per year. The average EPC improvement was from an E1 to a C3. Fuel switching rarely occurred for the sample, with 12% of homes switching fuel type. However, nearly all of these were from one fossil fuel to another. Indeed, almost 99% of homes remained on some form of fossil fuel after a WHS retrofit in 2024.

K-Means clustering identified two groups of homes with distinctly different retrofit measure installation patterns: "Fabric-First" retrofits focused on insulation and lighting with minimal heating upgrades and "Comprehensive" retrofits which typically involved full heating system upgrades, controls, and extensive fabric improvements.

Table 1: Comparison of identified retrofit clusters in terms of energy savings, costs, and cost of uplift.

Retrofit Cluster	Modelled energy savings (kWh/m^2/year)	Median cost (€)	Cost of uplift (€/kWh/m^2)
Fabric-First	23.05	18,751	814
Comprehensive	51.18	41,737	816

Table 1 presents modelled energy savings and actual project costs for both retrofit clusters. As expected, Comprehensive retrofits achieved substantially higher savings than Fabric-First retrofits (51.18 vs. 23.05 kWh/m²/year), but at a significantly greater cost (€41,737 vs. €18,751). The cost of efficiency uplift is notably similar between both approaches (816 vs. 814 €/kWh/m^2).

Regression models were used to isolate the effect of retrofit strategy within the EPC framework, helping to distinguish the clusters from other known drivers of performance. Differences between clusters in terms of modelled energy savings and costs remained after controlling for key dwelling characteristics. The models explain a reasonable share of the variance in EPC outputs (R^2 = 0.766 for energy savings; R^2 = 0.436 for cost). Results reflect internal relationships within the EPC model for energy outcomes, rather than observed performance.

Conclusion & discussions

The WHS remains a key instrument in tackling energy poverty and advancing residential decarbonisation in Ireland. By linking EPC and grant scheme data, this study provides a more granular assessment of WHS outcomes in 2024. Despite significant improvements in modelled energy performance, fossil fuel heating systems remained dominant across most retrofitted homes. This is particularly noteworthy given the revised Energy Performance of Buildings Directive, which prohibits incentives for stand-alone fossil fuel boilers from 2025. As such, scaling up heat pump delivery will be a key future challenge for the WHS.

Clustering analysis revealed that retrofit strategy is a key driver of both modelled energy savings and project costs, independent of other building characteristics. This highlights the importance of measure composition in determining retrofit outcomes within the EPC framework. The similar costs of efficiency uplift between Fabric-First and Comprehensive retrofits suggest that both options offer comparable value-for-money, which could inform policy in terms of funding allocations between lighter and more extensive retrofit strategies.

Although based on modelled data, the findings offer valuable insights into the performance of the WHS. Further research should validate these findings using metered energy data to assess real-world impacts. Incorporating occupant wellbeing outcomes, such as thermal comfort, health, and satisfaction, would also strengthen future evaluations. These are valid policy objectives for a programme targeting vulnerable households at risk of energy poverty, but are not captured in standard energy and carbon metrics.