# Are energy performance certificates a strong predictor of actual energy use? Evidence from high-frequency thermostat panel data

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## Motivations underlying the research

Improving energy performances of buildings is widely cited as one of the cost-effective approaches to address climate change, with building Energy Performance Certificates (EPCs) serving as benchmarks. For example, the Government of Ireland in its Climate Action Plan 2023 set a target of upgrading half a million existing homes, nearly a quarter of the housing stock, to a 'B2' Building Energy Rating (BER; the Irish EPC standard) by 2030 as part of the building decarbonization strategy. Similar EPC policy benchmarks are used in other countries, including the European Union and the USA.

National-level policies defined relative to certain EPC benchmarks implicitly incentivize households to target the specified EPC rating when investing in improving the energy efficiency of their dwellings. However, EPCs are generated based on projections from engineering models using standardized values for the number of occupants, energy use schedules, and other model parameters. Thus, the optimality of EPC related investment is determined by the accuracy of EPC in capturing actual dwelling-specific energy performance. Should a discrepancy exist, then household investment benefits and future emission targets might not be realized. This research evaluates the extent with which EPCs reflect observed energy demand for home heating, by focusing on building fabric performance while excluding occupants' behavioral effects.

## 2. A short account of the research performed

Our analysis exploits variations in boiler operation for home heating while the indoor temperature is within a small threshold of the thermostat's set point temperature during the main winter heating months in Ireland. This serves as a proxy measure of the variations in energy use for home heating across building energy ratings, attributed to building fabric performance alone.

The availability of high-frequency panel data (approximately every three minutes) on household thermostat set point, indoor temperature, and heating unit operating status from a smart thermostat company allows us to clearly identify the sole effects of building fabric performance across dwellings with different EPC ratings. This rich data enables us to capture the duration a home heating unit was in operation in the neighborhood of the thermostat set point temperature. In addition, we obtain access to hourly local weather variables and detailed data on building characteristics. We finally model the relationship between the duration a boiler operates and EPC ratings, conditioning on hourly outdoor temperature, relative humidity, windspeed, levels of the thermostat set point, several building characteristics, and type and efficiency of the main home heating unit.

## 3. Main conclusions and policy implications of the work

Our results indicate that improving a building's energy performance, as measured by EPCs, reduces energy use, but the difference in energy use attributed to the EPC ratings is modest, considerably lower than projected. This does not imply that upgrading a dwelling's energy efficiency is not beneficial. Rather, the findings underscore that EPCs are poor predictors of actual energy use and consequently cast doubt on the efficacy of public energy efficiency targets that are aligned to a specific EPC standard.

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