Sustainable Cities and Society 18 (2015) 56–65

Contents lists available at ScienceDirect

Sustainable Cities and Society

journal homepage: www.elsevier.com/locate/scs

Using census and administrative records to identify the location and occupancy type of energy inefficient residential properties

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ARTICLE INFO

Article history:
Available online 8 June 2015

Keywords:
Energy efficiency
Energy performance certificate
Building energy rating

ABSTRACT

The common EU framework for assessing the energy performance of residential buildings and awarding Energy Performance Certificates (EPCs) is an important resource in the context of informing effective policy measures to improve energy efficiency. However, properties that have been assessed to-date are not likely to be fully representative of the entire housing stock and therefore provides faulty baseline from which to devise policy actions. The paper presents a methodology to estimate the energy performance of all residential properties and combined with census data identifies what distinguishes the most energy inefficient properties, whether it is location, ownership, age or other characteristic. Data from the Irish EPC database suggests that 25% of the Irish residential housing stock is in the most energy inefficient categories, whereas the methodology developed suggests that it is substantially higher at 35%. The results also find that there is a substantially greater likelihood that the elderly, or families living in rental properties live in the most energy inefficient properties.

1. Introduction

The European Union, through the Energy Efficiency Directive, has established a common framework of measures to promote energy efficiency and achieve its headline target of a 20% improvement in energy efficiency by 2020 (CEC, 2010; EP and CEC, 2012). Within energy efficiency the greatest energy saving potential lies in buildings. Nearly 40% of final energy consumption occurs in buildings, and specifically within residential buildings, two-thirds of energy use is for space heating (CEC, 2011b). It is widely recognised that the energy savings potential within the residential building stock is large but given the heterogeneity of buildings both between and within countries there is very little precise information on exactly where the savings will be realised. Without such information it is difficult identify the residential buildings where energy efficiency savings can be achieved most easily and also to track progress toward policy targets.

Under the 2002 EU directive on energy performance of buildings (EP and CEC, 2002), which established a methodological framework for calculating energy performance, EU member states have been developing certification systems for rating the energy performance of buildings. These certification systems, which differ between countries, provide a standardised framework to provide an indication of the energy performance of residential buildings. One benefit of building energy ratings is they can act as a signal to property market participants who are willing to pay extra for more energy-efficient properties with lower running costs. Several studies have confirmed that properties with high energy rating certification can command a price premium both in residential (Australian Bureau of Statistics, 2008; Brounen & Kok, 2011; Cajias & Piazolo, 2013; Hyland, Lyons, & Lyons, 2014) and commercial buildings (Eichholtz, Kok, & Quigley, 2010; Kok & Jennen, 2012; Reichardt, Fuerst, Rottke, & Zietz, 2012).

Another benefit of building energy ratings is the information they provide relating to the energy efficiency of the building stock, which is of considerable interest in the context of energy efficiency policy targets. For instance, knowledge of energy performance across the entire building stock can provide a strong underlying basis for plans and measures to improve energy performance. Profiling the building energy rating by occupants provides an indicative assessment on the extent to which policy measures will be financed by occupants or whether grant schemes are likely to be more effective.

The EU's target of a 20% improvement in energy efficiency by 2020, of which building energy efficiency is a major component, is a Europe-wide target. Cost effectively achieving that target would entail investing in energy efficiency where it is cheapest to do so, irrespective of geography. But there is neither sufficient

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http://dx.doi.org/10.1016/j.scs.2015.06.001
2210-6707/

information nor policy mechanisms to consider a broad whole-Europe policy response to the target. Instead the policy response is at individual country level, where countries are required to prepare national energy efficiency action plans (NEEAPs) and revise them on a three-yearly basis. Among the outputs envisaged within the Energy Efficiency Directive (EP and CEC, 2012) and to be reported upon in NEEAPs are evidence-based strategies for mobilising investment in the renovation of the national stock of residential and other buildings. A good understanding of the status of the national building stock is an important basis for that work, as is knowledge of the means of households living within different building archetypes.

National databases on the energy performance of buildings offer a means to improve knowledge about national residential building stocks, their energy performance and where potential energy savings exist. These databases contain the information underlying building Energy Performance Certificates (EPC), which are usually required as part of mandatory data disclosure associated with selling or renting property. Exploiting national EPC databases will enable more accurate assessment of potential energy efficiency gains and the associated investment cost of retrofitting residential buildings. However, as the underlying legislation is relatively recent, EPC databases may not be representative samples of the building stock. Relatively new properties as well as properties that have been rented or sold in recent years are likely to be over-represented. The implication is that EPC databases may misrepresent the energy efficiency of the residential building stock, possibly indicating a higher level of energy efficiency performance than can be realized in practice.

EPC databases contain information on a large proportion of residential properties but in many instances less than half of all residential properties have been assessed; 50% in England and Wales, 40% in Scotland, and 30% in the Republic of Ireland.[1] In Ireland the EPC database is over-represented with relatively recently built properties, with 17% of properties built since 2006 (or 54% since 1991). This compares with census data (CSO, 2012a) which suggest that about 10% of properties were built since 2006 (or 41% since 1991). Nonetheless, EPC databases do contain sufficient information to enable estimation of the building energy ratings for the entire national residential building stock, as opposed to actual EPC ratings for an unrepresentative sample. With EPC estimates for the entire building stock, policy makers will be better informed as they design measures to improve the residential sector's performance with respect to both energy efficiency and climate policy targets.

This paper presents a methodology to estimate EPCs for a national residential building stock using limited information on building characteristics without the need to undertake costly, on-site EPC assessments. The methodology also provides insight into the profile of the households living within properties across EPC ratings. We use data from Ireland to demonstrate the methodology but the approach should be easily replicable in other EU member states, where the same policy context exists in terms of developing evidence-based strategies for mobilising investment in building energy efficiency.

Developing a methodology to estimate the energy performance of the national building stock serves a number of policy-related purposes. In the context of improving energy efficiency in buildings it helps identify the type, number and geographical location of buildings where the most significant energy efficiency gains can be achieved. It also provides detailed information about households living in energy inefficient properties, including tenure of occupancy, household disability status, and the age profile of occupants. Knowledge of such information can assist in the design of targeted incentive schemes for investment in energy efficiency upgrades. It will also help in estimating investment costs associated with energy efficiency improvements to achieve policy targets, as well as estimating the energy efficiency potential from remediation works on the residential building stock.

The paper proceeds with further discussion of the policy drivers for improving energy efficiency and how enhancing the knowledge base surrounding the residential housing stock will facilitate that work. Section 3 outlines the methodology employed to improve the estimates of residential energy efficiency. The data used to illustrate the methodology are described in Section 4 and the estimation results are presented in Section 5. Section 6 contains a discussion of the results drawing policy conclusions about where public policy should prioritise measures to improve residential energy efficiency. Conclusions are summarised in Section 7.

2. Policy context

The Energy Efficiency Directive (EP and CEC, 2012) is the EU's main legislative mechanism for implementing energy efficiency policy supported by a number of other directives such as the energy performance of buildings directives (EP & CEC, 2002; EP & CEC, 2010). Energy efficiency is central to the EU's Europe 2020 Strategy for smart, sustainable and inclusive growth and for the transition to a resource efficient economy (CEC, 2010). The strategy recognises that energy efficiency is the most cost effective way to reduce emissions, improve energy security, increase competitiveness and employment, as well as make energy more affordable. Energy efficiency is the flagship initiative under the Europe 2020 Strategy (CEC, 2011a) and within the Commission's energy efficiency action plan buildings are identified as the area where the greatest energy saving potential lies (CEC, 2011b). The action plan focuses on developing instruments to trigger the renovation process in buildings and to improve building energy performance. A key element of any plans to trigger building renovation is a better understanding of the quality of the building stock and identifying where building improvements will achieve the greatest gains. Understanding the extent to which the greatest gains in energy efficiency coincide with occupants/owners (un)willingness or (in)ability to finance building refurbishment should affect National Energy Efficiency Action Plans.

Across Europe the scale of energy savings potential is immense. Between 1996 and 2007 energy efficiency savings totalled approximately 160 million tonnes of oil equivalent (ADEME, 2009) but even with such progress the EU is on course to achieve only half of its ambitious 20% target for energy efficiency improvement by 2020 (CEC, 2011b). Similarly impressive energy efficiency savings have been achieved in Ireland with 26% of the national savings target for 2020 achieved by 2012, representing savings of €470 million in energy costs and 2 million tonnes of carbon dioxide equivalent emissions (DCENR, 2012). In Ireland much of the savings to date are attributable to new building regulations but future savings are most likely to be realised within existing buildings. Similarly across Europe the extensive refurbishment of the existing housing stock will be necessary to achieve energy efficiency targets. Good knowledge of the building stock and its energy performance will be necessary to develop effective policy measures to incentivise the refurbishment of existing dwellings. While there are instances where there is detailed information to inform policy (e.g., DCLG, 2010) in many cases the knowledge base is quite limited. On-site energy assessments to develop representative sample databases

[1] For England and Wales see www.epcregister.com/lodgementStats.html; For Scotland see ⟨www.scotland.gov.uk/Topics/Built-Environment/Building/Building-standards/enerperfor/epcstats; and for the Republic of Ireland see www.seai.ie/Your_Building/BER/BER_FAQ/FAQ_BER/General/BER_Statistics.html⟩. (Accessed 24.03.14).