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The influence of energy audits on the energy efficiency investments of private owner-occupied households in the Netherlands

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HIGHLIGHTS

- A high percentage of audit recommendations were ignored by audit recipients.
- Many energy saving measures were installed which were not recommended in audits.
- The installation of one or two energy efficiency measures remains the norm.
- Householders without an audit installed more and invested more in measures than those with an audit.
- A case is made for minimum efficiency standards and performance based incentives.

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ABSTRACT

Energy audits are promoted as an effective tool to drive investment in energy efficiency measures in the residential sector. Despite operating in many countries for several decades details of the impact of audits are mixed. The aim of research presented here is to explore the role of audits on investment in energy efficiency measures by private owner-occupied householders in the Netherlands. Results showed that the main influence of the energy audit was to confirm information held by householders. A significant portion of audit recommendations was ignored, the main reason being that householders considered their dwellings to be adequately energy efficient. A comparison of audit recipients to non-recipients showed that audit recipients did not adopt, plan to adopt or invest in more energy efficiency measures than non-recipients. In fact non-recipients adopted more and invested more in measures. It is concluded that energy based renovation is driven by householder perception of comfort and acceptable outlay on energy bills and not necessarily to expert technical tailored information on the potential to reduce CO_2 emissions and environmental impact. Results support arguments for minimum energy efficiency standards and performance based incentives.

1. Introduction

Climate change policy gives existing dwellings a key role in reducing greenhouse gas emissions by 20% by 2020 and 50–80% by 2050 (EC, 2011). In quantity and quality terms there is considerable scope in existing dwellings for energy efficiency improvement. The European Commission (EC) (2006a:5) estimates a cost effective potential to reduce energy use by 27% in the residential sector primarily through measures such as roof and wall insulation. Moreover, it is stated that energy savings can be achieved in existing dwellings more cost effectively than any other sector (Levine et al., 2007; Ürge-Vorsatz et al., 2007). Alongside meeting climate change targets there are multiple positive spin-offs, such as, reduced household expenditure on energy bills, improved occupant health, reduced dependence on non-renewable fuels and protection of environmental resources. However, despite broadcast benefits a considerable gap between estimated energy saving potential and reality persists (Blumstein et al., 1980; Jaffe and Stavins, 1994; Weber, 1997; Curtain and Maguire, 2011). There are a number of explanations as to why householders do not invest in energy efficiency measures. One explanation is that they do not have adequate information to assess options and potential savings (Gates, 1983; Schleich, 2004; Löfström and Palm, 2008).

A range of policy tools are considered capable of overcoming this information deficit. Promoted as one of the most effective is face-to-face advice that is tailored to a particular household's energy requirements and dwelling characteristics (Stern, 1992; Benders et al., 2006). Energy audits are endorsed by organisations such as the IEA, the OECD and the EC (OECD, 2003; EC, 2006b; OECD/IEA, 2010). The EC urges Member States to establish

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programmes for audits: "In order to realise the energy savings potential in certain market segments where energy audits are generally not sold commercially, such as households, Member States should ensure the availability of energy audits" (EC, 2006b: L114/66).

However, despite the endorsement and theoretical assumptions about cause and effect there is a little empirical data that proves if energy audits function as intended. This knowledge gap is not unique to energy audits but is pervasive for policy instruments designed to improve household energy efficiency. For several decades researchers have bemoaned the lack of systematic evaluation of instruments and the consequent lack of understanding about the true nature of barriers, the overall effectiveness of instruments and general principles underlying the formulation of instruments (Blumstein et al., 1980; Jaffe and Stavins, 1994; Fairey and Goldstein, 2006; Lowe and Oreszczyn, 2008; Maio et al., 2012).

In response to this research gap an extensive survey of Dutch households was conducted in 2012. The main aim of the survey was to examine the energy efficiency measures adopted and planned by households and the awareness, use and influence of different policy instruments on their action and plans. The focus of the survey was the uptake of energy efficiency measures requiring considerable monetary investment, for example, insulation and micro-generation technologies. These measures hold the most potential to reduce energy use for space and water heating (accounting for over 70% of residential energy use) (Itard and Meijer, 2008). The survey was limited to homeowners as this represents the single largest share of the housing market in the Netherlands and is therefore considered to represent the largest possible savings.[1] Furthermore, the instruments developed for owner-occupiers are distinct from those aimed at social and private landlords for which it is considered separate surveys would be more appropriate.

One objective of the survey was to identify the impact of energy audits. This objective was reached by (a) analysing the influence of audits as reported by respondents and (b) analysing the difference in energy efficiency investment behaviour between audit recipients and non-recipients. In the next section the theoretical background is outlined followed by an overview of previous research. The survey design and statistical tests adopted for analysis are presented in Section 4. Results are presented in Section 5 and in the last section results are discussed and recommendations are proposed.

2. Theoretical background

2.1. Barriers and information

The barrier model is typically used as a basis for the development of instruments. Along with financial constraints, lack of time and hassle; lack of information is viewed as a barrier preventing an otherwise assumed natural pursuit of cost effective household energy performance improvement (Jaffe and Stavins, 1994; Vedung and van der Doelen, 1998; Schleich, 2004). According to the OECD/IEA (2010:11) "The theory is simple: barriers can be overcome with the design and implementation of targeted energy efficiency policies".

An array of tool comes under the information banner. As well as energy audits mass media campaigns, promotional pamphlets, interactive web based tools, workshops, smart meters and informative billing are common examples. A number of efforts have been made to categorise information tools. Hood (1983) discusses information instruments as 'general', 'group targeted' and 'custom-made'. Others categorise information as antecedent (goal setting, information etc.) and consequence (feedback) (Abrahamse et al., 2005). Further categorisations focus on the role of the energy end user with the division of 'opportunistic advice' (provided when new equipment is installed or householders move dwelling) and 'client-led advice', when householders request the information (New Perspectives, 2002).

Energy audits belong to the 'custom made' and 'antecedent' categories and they can be either 'opportunistic' or 'client-led'. In the information tools family it is custom-made audits that are viewed as holding the most potential in stimulating the installation of energy efficiency measures (Gates, 1983; Stern, 1992; New Perspectives, 2002; Benders et al., 2006). "Social psychologists and marketing professionals know that information is more likely to change behaviour when it is specific, vivid and personalised" (cited in Stern, 1992: 1227).

The specificity and comprehensiveness of energy audits are illustrated in definitions and descriptions. The European Energy Service Directive defines an energy audit as: "a systematic procedure to obtain adequate knowledge of the existing energy consumption profile of a building or group of buildings…identify and quantify cost-effective energy savings opportunities, and report the findings" (EC 2006b: L114/68). National or international standards are typically followed during the audit process (Novikova et al., 2011). Breukers et al. (2009:82) and Novikova et al. (2011) emphasise the face-to-face contact associated with an energy audit as a distinguishing feature. This face-to-face element makes audits more engaging than tools such as the Energy Performance Certificate (EPC) required under European legislation when buildings are constructed, sold or rented but without the involvement of the 'would-be' occupant.

To summarise, the theoretical assumption is that an energy audit can remove the information deficit and unnecessary information overload by providing bespoke advice on the extant efficiency of the dwelling, recommended energy efficiency measures and expected savings in energy use and energy bills. Once armed with this information it is assumed that householders are more likely to install the energy efficiency measures recommended to them, all the more so if they have requested the audit. This brings benefits to the household and reduces the environmental impact by contributing to, inter alia, climate change policy objectives. The aim of research presented here is to furnish this assumption with empirical evidence from the Netherlands.

2.2. Instrument implementation

As well as theories about barriers two commonly accepted theories in this domain are that a mix of instruments should be implemented and that instruments should be performance based. A mix of policy instruments is required to target multiple barriers and market transformation opportunities (Gunningham and Sinclair, 1999; Ürge-Vorsatz et al., 2007). Meanwhile, a performance based approach is required to encourage deep retrofit instead of the installation of one-off measures (Fairey and Goldstein, 2006). As well as the preferred approach in terms of cost effectiveness it is argued that deep retrofit is required if existing dwellings are to deliver on climate change targets.

3. Previous research

3.1. Effects of audits

Several research projects refute the assumption that tailored advice overcomes the information deficit and stimulates investment

[1] Housing tenure in the Netherlands is approximately 60% owner occupied, 10% private rental and 30% social rental.

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