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Short Communication

Will domestic consumers take up the renewable heat incentive? An analysis of the barriers to heat pump adoption using agent-based modelling

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HIGHLIGHTS

- We examine the uptake of the UK Renewable Heat Incentive (RHI).
- We use Agent-based modelling to simulate uptake in a heterogeneous population.
- Simulation modelling suggests that uptake is sensitive to non-financial barriers.
- Non-financial barriers were introduced after RHI policy impact assessment.
- New barriers combined with sensitivity could explain observed lower than expected uptake.

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ABSTRACT

The UK Government introduced the tariff-based domestic Renewable Heat Incentive (RHI) in April 2014 to encourage installation of renewable heat technologies as a key component of its carbon reduction policy. Of these, heat pumps are considered to be the most promising for widespread adoption and as such are the subject of this paper. Pilot studies prior to introduction of the policy identified non-financial barriers to uptake, such as the "*hassle factor*" involved, and initial figures indeed indicate that uptake is lower than expected. We analyse these non-financial barriers using an agent-based model and conclude that there is a tipping point beyond which adoption is likely to fall very sharply. We suggest that the RHI's complex and stringent compliance requirements for home inspections and heat emitter performance may well have driven adoption past this point and that further intervention may be required if the key aims of the RHI are to be achieved.

1. Introduction

In April 2014 the UK's Department of Energy and Climate Change (DECC) launched the domestic Renewable Heat Incentive (DECC, 2014a), with the claim that it is "the world's first long-term financial support programme for renewable heat, offering homeowners payments to offset the cost of installing low carbon systems". The RHI scheme offers a tax-free, index-linked, per kWh tariff payment with 2014 rates between £0.073 and £0.192 depending on technology. These payments are based on metered or estimated thermal energy outputs from renewable heat technologies (RHTs), with a tariff lifetime of seven years. The RHI tariffs are "set to compensate householders for the additional costs of installing renewable heat technologies compared to conventional heating technologies" (DECC, 2013b). In this paper we are concerned specifically with the ability of the RHI to encourage adoption of heat pumps on a sufficient scale to achieve their expected major contribution to the government's ambitious strategy for reduction of carbon emissions from the 22% of total energy use for domestic heating. Heat pumps are expected to be adopted initially in rural areas off the gas network (DECC, 2013e, p.9), and then penetrate suburban housing to become the main alternative to a heat network connection (Fig. 1).

Calculation of the tariff payable on a heat pump installation is as follows. A heat pump delivers a thermal energy output E_o that is a multiple of the input energy E_i, normally electricity. This multiple, known as the Coefficient of Performance (CoP), is typically in the range 2–4. It is the additional thermal output that can be considered renewable heat under this scheme because it is in effect extracted from the air in the case of an air source heat pump (ASHP) or from the earth by a ground source heat pump (GSHP).

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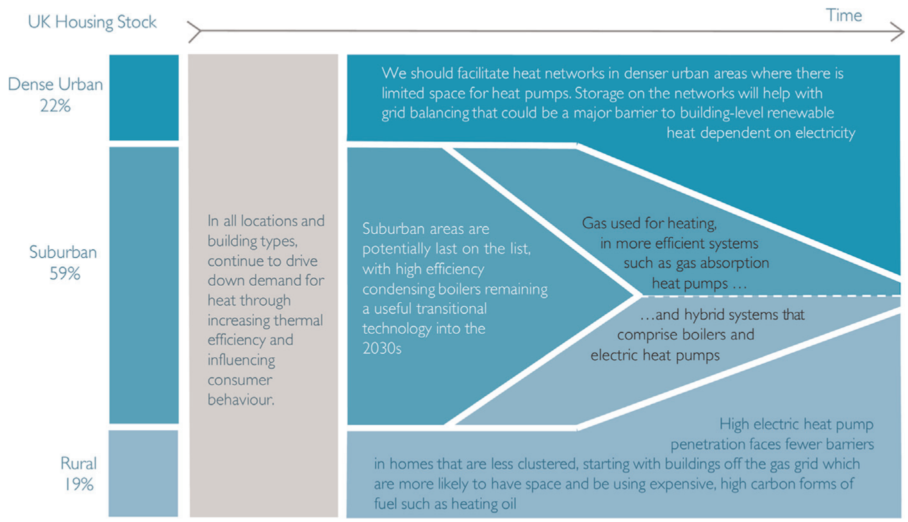

Fig. 1. Strategy for decarbonisation of domestic heating to 2050. Source: DECC (2013a).

The renewable heat E_r potentially attracting a tariff is therefore:

$$E_r = E_o - E_i \quad (1)$$

The UK policy is also affected by the European Union (EU) Renewable Energy Directive (EU, 2009), which requires that a heat pump must achieve a CoP of at least 2.5 for any of its output to be considered renewable. This is not a trivial requirement in the UK, where research revealed median CoP values of 2.2 for GSHPs and 2.0 for ASHPs (Energy Saving Trust 2010). This relatively poor performance compared to elsewhere in Europe influenced the late introduction of more stringent eligibility requirements for the RHI (see Section 2.1).

1.1. *Predicted impact of RHI and initial outcome*

Predictions for the uptake of the RHI over the 7 financial years to 2020/21 are given in DECC (2013b). Fig. 2 shows the cumulative numbers of ASHPs and GSHPs expected to be installed under central estimates. High levels of uncertainty are recognised by DECC, corresponding to the error bars shown.

Data are now available for the uptake during the first 5 months of the policy (DECC 2014b, Table 2.1). These show 1435 applications for the new ASHP installations and 292 for new GSHP applications[1]-as well as 5961 legacy ASHP and 2794 legacy GSHP. Of the total applications, for ASHP 5006 of the 6039 were by owner occupiers (2281 of 2468 for GSHP), with the remainder being mainly due to social landlords. The figures for new applications are an indicator of the RHI uptake "run-rate". Since the predicted totals for 2014/15 were 15,180 (ASHP) and 6600 (GSHP) these half-year figures are clearly dramatically below the levels anticipated even allowing for some temporary impediments in the application process immediately following introduction of the policy. The RHI is framed initially to offer repayment of the consumer's additional cost over that which would be needed for a non-renewable system, with interest at 7.5% (DECC, 2013b). This makes the low uptake somewhat surprising as, on the face of it, the RHI makes the installation of RHTs an attractive option to owner-occupiers with savings. This apparent attractiveness combined with the evidence of lower adoption rates than predicted suggests that there are other barriers discouraging uptake.

We investigate the sensitivity of the RHI policy to these non-financial barriers using an agent-based modelling (ABM) approach, providing a different perspective to that employed in DECC

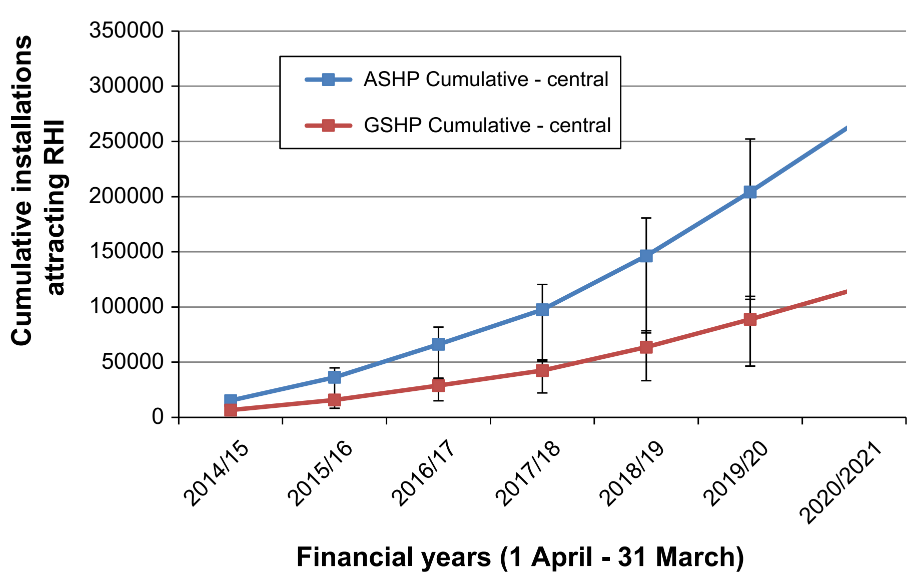

Fig. 2. Predicted cumulative installs of ASHP and GSHP attracting RHI (DECC, 2013b).