Programme Area: Smart Systems and Heat

Project: Value Management

Title: Overcoming barriers to smarter heat solutions in UK homes - Annexe 2b: Cost benefit analysis of policies

Abstract:

This document was prepared at the time to contribute to ETI internal thinking and planning only.

Context:

This project studied how value can be delivered across a smart energy value chain - in the context of the UK. It built a clear understanding of how smart energy systems can deliver combined consumer value alongside commercial value for market participants - producers, suppliers, distributors. The analysis will help to make the commercial deployment of smart energy systems more likely. This £600,000 project was delivered by Frontier Economics, a leading economic consultancy.

Overcoming barriers to smarter heat solutions in UK homes

Annexe 2b: Cost benefit analysis of policies

PREPARED FOR THE ETI

March 2015

1 Overview

This annexe provides a quantitative appraisal of the five policies highlighted as being promising in our evaluation of policy options (annexe 2a):

- stamp duty rebates;
- council tax rebates;
- grants;
- including energy bills in headline rental prices; and
- a package of regulation and support for district heat.

Policies such as these will succeed or fail based on their ability to overcome barriers to the take up of low-carbon heating interventions. As many of these barriers are intrinsically difficult to model, many of the most useful insights from this exercise are qualitative in nature, and these are summarised in the box below.

In the remainder of this document, we set out the framework used for the quantitative analysis, and present results for each policy in turn.

Insights from the cost-benefit analysis

Some of the key insights we have drawn from this analysis are as follows.

- Financial incentives are not likely to be required to drive uptake of HEMS Plus[1] and cavity wall insulation, as these are cost-effective for most consumers, even with no carbon price on gas in place.

- It will be very expensive to drive uptake of solid wall insulation and heat pumps using financial incentives. This is because consumers are only likely to respond to measures that have a payback period of less than 10 years. To bring the payback period down to below 10 years, for 1m solid wall interventions and 2.5m heat pump interventions (i.e. the levels which may be required to meet 2050 targets), very high subsidies would be required. The cost of subsidies at this level would be extremely high – for example, over £25bn to incentivise heat pump and solid wall insulation uptake. Costs could be even higher if subsidies were not applied in an efficient manner.

- Policies that tie into infrequent trigger-points (such as moving house) will be associated with a gradual take-up of interventions. Policies that do not tie in to trigger points (such as grants) can potentially lead to a more rapid take-up, but in reality may fail to overcome barriers to take-up in the first place, due to customers' inertia. It would be helpful if this trade-off could be assessed (potentially through the use of trials) before policies are put in place.

- On their own, policies that align incentives between landlords and tenants may fail to increase intervention uptake. This is because even when incentives are aligned for more costly interventions such as heat pumps and solid wall insulation, all the barriers that affect homeowners (such as long payback periods) still apply. Complementary policies to reduce those barriers would also be required.

- To be successful, district heating is likely to require a combination of policy measures (grants to developers, regulation, licensing, and risk-sharing), aimed at high-density areas where the economics of district heating work best.

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1 HEMS Plus is a sophisticated Home Energy Management Controller with zoning and hot water management

1.2 Analytical framework and summary of results

As explained in the main report, consumers may fail to take up low-carbon interventions (such as insulation, HEMS Plus or heat pumps) due to a variety of different barriers. These barriers arise from interactions between characteristics of the market, consumers, and interventions. In particular, we have identified four areas where a response may be required to overcome these barriers.

- **Find the added value for consumers, or compensate them.** We cannot ignore the fact that many consumers are happy with their existing heating systems, and that some low-carbon interventions will not make them better off, either financially or in terms of the heating service they receive. While cavity wall insulation and HEMS can improve the heating service for consumers and save them money, important barriers exist for district heat, solid wall insulation and heat pumps. For district heat, costs need to come down so it can compete with the incumbent gas boilers. For heat pumps and solid wall insulation, it is about bringing costs down *and* improving the service consumers receive, for example, by tackling issues around performance, aesthetics, risks and hassle associated with installation.

- **Make it easier for consumers to choose low-carbon interventions**. At the moment, consumers' decisions are stacked against low-carbon interventions. Low interest, low awareness and a tendency to choose in "distress", means that consumers will tend to go for the familiar incumbent options, or nothing at all. It is therefore necessary to find ways of making it easier for them to choose low-carbon interventions, for example by engaging with consumers at different times, in different ways, or with a different focus.

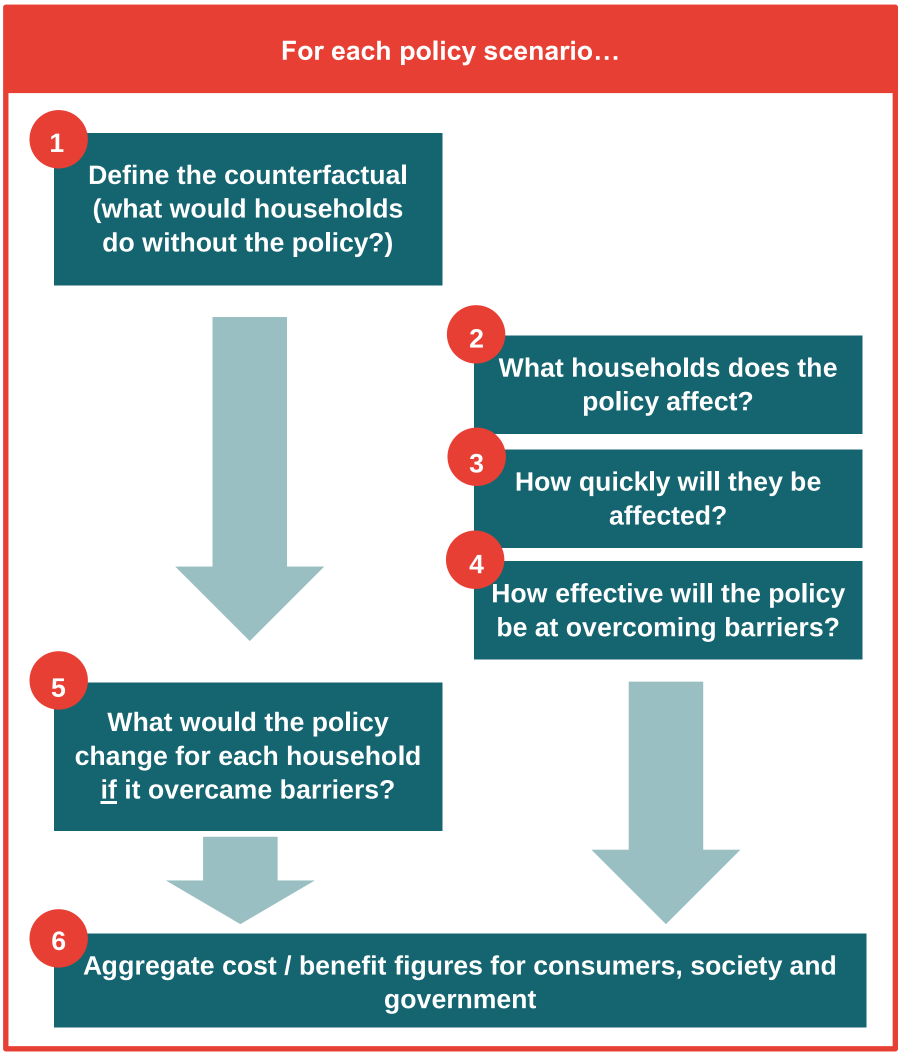
- **Manage upfront costs.** The high upfront costs associated with low-carbon interventions result in an important barrier to uptake, when combined with consumers' focus on near term costs and benefits, credit constraints and misaligned incentives between landlords and tenants. Again, this barrier means that even where interventions are in consumers' best interests, they may not take them up.

- **Ensure natural monopolies deliver for consumers.** Finally, intervention will be required to ensure natural monopolies in district heat can deliver the best possible service for consumers.

We also noted that policies that seek to overcome these barriers should **focus on consumers with the most to gain**. The small size and relative immaturity of the market drives barriers related to cost and lack of familiarity. To overcome these, it makes sense to focus on those consumers with the most to gain – either in terms of financial savings (for example, high energy users), or in terms of health and wellbeing (for example, the fuel poor). Working with the market and not against it can help businesses reach uptake levels that increase viability and reduce policy intervention costs.

Policies will succeed in incentivising the take-up of interventions only if they are able to mitigate all the relevant barriers. The effect of a policy (upon consumers, the exchequer, and society as a whole) will depend on both whether it is able to overcome these barriers and the effect for each household where barriers are overcome. We have used this framework within the cost-benefit analysis, as illustrated in **Figure 1**.

Figure 1. Cost-benefit analysis framework



Source: Frontier Economics

First, we set out the counterfactual[2] – the world we think would exist in the absence of the policy. The benefits and costs of the policy will be assessed in relation to this counterfactual. We are assessing each policy on its own, and therefore assume that no policies (or business models) specific to increasing intervention uptake are in the counterfactual. However, the analysis does then go on to explain where certain policies may need to be provided in tandem.

2 This counterfactual is different from the counterfactual used within BMET, which assumes that a carbon price is in place. Within BMET (which assesses business models, rather than policies), the carbon price acts as a general proxy for any Government policy aimed at increasing intervention uptake. When assessing a policy by contrast, we assume that there is no carbon price policy in place.

The next set of analysis considers how the world under the policy may differ from the counterfactual.

- We determine what proportion of UK households the policy would apply to. This starts to place an upper limit on how effective the policy could be.

- Some policies are tied to a specific "trigger point", which can delay their effectiveness. For example, a policy tied to house moves can only incentivise take-up whenever a household moves, which will slow down any resulting take-up of interventions. However, policy targeted at such a trigger point (as opposed to a policy which is always available) may increase the chance of intervention take-up, described in the following section.

- We then consider how likely it is that the policy in isolation, leads to intervention take-up among different types of household. As set out in the main report, this requires that the policy overcomes all barriers to uptake.

- Finally, we determine, for those customers where the policy overcomes barriers to uptake, the cost or benefit (relative to the counterfactual) for:
  - consumers;
  - the government (assuming at this stage that any costs of subsidies are faced by the government or taxpayers, rather than placed on energy bills); and
  - society as a whole.

Where possible we have quantified each parts of the calculation described above to derive an assessment of the aggregate costs and benefits.

There are important caveats to the headline figures. In practice, it is not possible to quantify some important costs and benefits. In particular, bottom-up modelling as used in BMET cannot be used to predict consumer behaviour in the presence of factors such as lack of trust and low interest. Trials would be required to examine how different policies can overcome different barriers. We have therefore provided results for some indicative scenarios regarding the success of the policy in overcoming different barriers. We have used BMET to estimate whether the policy may overcome barriers relating to overall value-for-money, and have then considered whether other barriers may hold using a more qualitative approach.

2 Policies that offer financial incentives

We first analyse the three policies that offer financial incentives to consumers: Stamp duty discounts, council tax rebates, and grants.

These policies all aim to give up-front financial incentives to consumers to take up energy efficient interventions. For the modelling, we have specified that the cost of incentivising each intervention is set at a level that internalises the *average* value of carbon savings associated with that intervention (the actual level of carbon benefits varies by customer group). This is assumed to be the same level of support across all three policies.

We assume that this support would be focussed on those measures which would not be cost-effective to consumers absent policy interventions: solid wall insulation and heat pumps. We cover district heat in a separate section below. We assume that no support is provided for those technologies that consumers would take up anyway (HEMS Plus and cavity wall insulation, as discussed below). Furthermore, analysis with BMET indicates that electric resistive heating is not a cost-effective intervention even in the presence of a carbon price. We have therefore assumed that the policy would not cover this intervention.

The size of the rebate given is the same across each policy. We have therefore treated these policies together, highlighting where they vary in terms of:

- who the policies applies to;
- how often might the policy be triggered for a household; and
- how effective might be the policy in overcoming barriers.

2.1.1 Counterfactual

The first step is to assess the counterfactual, which is the same across all three policies.

Using BMET, we have estimated the interventions that different groups of consumers might take up if there were no government incentives (such as a carbon price) in place.

This modelling indicates that all customer groups would take up HEMS Plus at some point between 2015 and 2030. Additionally, the one group with uninsulated cavity walls is assumed to insulate them in 2015. There is no take-up of solid wall insulation or low-carbon heating systems (heat pumps or electric resistive systems).

BMET takes into account barriers relating to the cost-effectiveness and initial cost (credit constraints) for each intervention, but does not take into account other barriers.[3] We therefore considered whether non-modelled barriers might lead to lower take-up of interventions.

- As explained in the main report, barriers to uptake of HEMS Plus may be relatively low (Hive and Nest have already been taken up in significant numbers, despite time-of-use tariffs that could increase their effectiveness not yet being in place).

- Cavity wall insulation also appears to have relatively low barriers to uptake – a high proportion of cavity walls have already been insulated, and the process is non-invasive.

We also examined the payback period of these interventions. The research presented in the main report and in annexe 3b on payback periods shows how customers can have a focus on near-term costs and benefits. It is therefore unlikely that consumers would wish to take up an intervention with a long payback period, or that business model would be able to offer unsecured loans for a long period. For the purpose of this cost-benefit analysis (and drawing on the analysis in annexe 3b), we consider that consumers will not take up interventions with a payback period of above ten years.[4]

HEMs Plus and cavity wall insulation have relatively short payback periods (annexe 3b shows how, even without a carbon price, payback periods are under ten years). **For the purpose of this cost-benefit analysis, we have therefore assumed that, absent any government policies, HEMS Plus would be taken up by the majority of customers, while cavity wall insulation would be taken up by the group of customers ("Transitional Retirees" in BMET) that do not already have it.**

2.1.2 Who does the policy apply to?

The main distinction here is between policies that would give a financial incentive to the owner of the property (stamp duty discounts and grants), compared to policies that would give a financial incentive to the occupier (council tax rebate).

Stamp duty discounts

This policy would offer a one-off rebate on stamp duty to homeowners, payable when measures are installed in the home. Buyers could claim this either at the point of sale or in the first twelve months after it. The discount could be calculated using the Standard Assessment Procedure (SAP) or EPC framework,

3 Other than an artificial "hassle cost" accounting for a lack of awareness of interventions, which falls from £1,000 in 2015.

4 This assumes there are no other non-monetary factors that could drive take-up – for example, the way that external wall insulation can enhance the look of some properties.

and could be based on the value of the carbon savings associated with each measure.

This policy would apply upon the sale of any residential property. Although no stamp duty is applicable on homes with a sale value of under £125,000, we have assumed in these cases that the policy effectively acts as a grant.

On the assumption that all properties (whether owner-occupied or rented) will eventually be sold, this policy may therefore apply to **100%** of UK households. **65%** of these properties are owner-occupied. In the case of the remaining **35%** of rented properties (whether privately or socially rented), the policy would provide an incentive to the landlord, not the tenant.

Council tax rebate

The policy is effectively a type of one-off cash-back scheme for households which install measures. Households would qualify based on providing receipts for the improvement measures.

Note that this policy differs from the stamp duty policies in some ways that we do not model. For example, using council tax as a vehicle for subsidies is potentially helpful as the subsidies could be set at a level appropriate to different local areas. However, such a policy may run into opposition if the public view council tax as a means for paying for local services, rather than a more general tool for government.

We have assumed that this policy would apply to all residential properties for which council tax is paid. This accounts for 94% of households, based on the English Housing survey 2012-13 (full-time students and a small number of other groups do not pay council tax).

For rented properties, the council tax rebate would be paid to the occupier rather than the owner (we discuss below the effects this has on the policy's ability overcome barriers in the rented sector).

Grants

Grants would provide a similar incentive to council tax rebates and stamp duty, though this policy differs in that it is not tagged to an existing policy structure. Grants could potentially be made available to **100%** of households. We have modelled the grants as being payable to the individual who installs the interventions – either an owner-occupier, or the landlord of rented properties.

2.1.3 How often might the policy be triggered for a household?

Stamp duty discounts

Homeowners would only be able to take advantage of this policy when they purchased a new property. 65% of households are owner-occupiers, and each year 3% of households move to an owner-occupied property.[5]

As a result of being tied to a relatively infrequent trigger point, this policy would be unable to facilitate the take-up of interventions over a short period. A slower intervention roll-out will delay the benefits, producing a lower net present value. However, as described below, the use of this trigger point may lead to greater success in overcoming perception barriers.

Council tax rebate

Council tax is paid monthly. If the rebate was attached to a monthly bill, it could be claimed at virtually any point.

Grants

2.1.4 We have modelled the grant as being available at any point.

2.1.5 How effective in isolation might the policies be at overcoming barriers?

As discussed in the overview, we have considered four areas where policies may need to address barriers:

- find the added value for consumers, or compensate them;
- make it easier for consumers to choose low-carbon interventions;
- manage upfront costs;
- ensure natural monopolies deliver for consumers.

Below, we discuss how successful the three financial incentive policies might be at overcoming the first three of these (natural monopolies do not apply to the household-level interventions we consider here).

Find the added value for consumers, or compensate them

We have used BMET to model customer uptake of interventions if the rebate is applied. BMET models the overall value of the intervention (including the rebate), and the effect of the rebate upon credit constraints.[6] However, it does

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5 Figures from English housing Survey 2012-13

6 Within BMET, it is assumed that households have a set limit for how much they can spend in a given year on energy interventions. If the intervention is unaffordable as a lump-sum, they have

not consider any other barriers which may remain: these other barriers are discussed below.

For owner-occupiers, all three policies amount to the same lump-sum subsidy. This is modelled as leading to the following additional (in excess of the counterfactual) take-up of interventions.

- Young Starters and Greener Graduates take up solid wall insulation in 2040;
- successful Ruralites take up solid wall insulation and a heat pump in 2015; and
- off Grid Rural Electric take up solid wall insulation in 2025.

For rented properties, the policies do not correct the underlying split incentives, and as a result we model them as not increasing uptake amongst the 35% of houses that are rented.

- Although landlords could receive the **stamp duty discounts**, we have assumed that landlords are unable to capture the fuel savings of interventions through rent (this is addressed in the "including bills in headline rent figures" policy discussed below). Given this, the stamp duty discount policy on its own is insufficient to incentivise any additional take-up of interventions within the rented sector.[7]
- The **council tax rebate** would be received by tenants. However, it is landlords who ultimately have to invest in interventions. If the rebate was not passed through into rental values, this policy would produce no incentive for landlords to invest in interventions.
- The **grants** policy, as with the stamp duty discounts, would apply to landlords. In the absence of further policies to mitigate the split incentive between landlords and tenants, this policy would not incentivise take-up of interventions for owner-occupiers.

Make it easier for consumers to choose low-carbon heating interventions

Some of the barriers to intervention uptake are due to a lack of customer awareness and attention. This policy involves a lump-sum grant: as explained in

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access to credit. Owner-occupiers within BMET are assumed to have access to a mortgage loan of either 10 years at a real interest rate of 4%, while renters are assumed to have access to a Green-Deal type loan of 15 years at a real interest rate of 7%.

7 This is inherent in the way this particular policy is designed to ensure that subsidies cannot exceed the capital cost of interventions.

annexe 3b on payback periods, bringing benefits forward in this way can increase uptake if customers have a tendency to focus on the short-term.

The stamp duty discount policy would tie into a significant trigger point (moving house, when customers may be thinking of making renovations). This may also help increase uptake.

Other potential barriers include the hassle of installing interventions, and the performance risk that consumers may perceive from installing unfamiliar technologies. Although we have not quantified these barriers, we note that business models may be able to mitigate some of them (for example, through the use of a "facilities management" type contract, where the business model provider (which is familiar with the technologies) bears the risks that the consumer would otherwise have. Annexe 3d on the counterfactual and business models includes further information on the elements of a business model that could increase uptake.

Manage upfront costs

The level of rebate that we have modelled, while large enough to make the interventions (heat pumps and solid wall insulation) pay off in the long-term, is not enough to produce a payback period of below ten years.

As discussed in annexe 3b, this may be a substantial barrier to consumer take-up of interventions which business models alone cannot solve. We discuss the implications for this (how much would have to be paid to overcome this barrier) below.

2.1.6 If the policies overcome barriers, what effect would they have?

We now look at the costs and impacts of the policies, for each household taking up measures in response to the incentives. As explained above, we will later look at how the number of households taking up measures differs, depending on which incentive is applied.

The impact of the policies on a per household basis would vary, depending on the attributes of the households. These attributes are represented as customer groups within BMET. **Table 1** shows each BMET representative household for which the policy may increase[8] take-up: For each of these it also shows:

- the year in which BMET predicts that intervention uptake starts to take place with the rebate;

[8] We have only included groups if the rebate is modelled as leading to overcoming barriers associated with value-for-money, credit constraints, and payback periods. If other barriers (such those around awareness and attention) cannot be overcome, some of this uptake may not occur.

- the direct cost to the government per household (i.e. the level of the rebate);
- the overall effect on the consumer per household (i.e. bill savings, minus capital costs, plus the rebate);
- the value of carbon savings per household (calculated using DECC's central projections for carbon prices); and
- the overall social cost/benefit to UK PLC, which is equal to the sum of the other three components.

Table 1. Impact of policy per customer group (per household £)

Group	Measure	Year	Govt	Consumer	Carbon savings	UK PLC
Young Starters	Solid wall insulation	2040	-6,179	2,941	5,152	1,914
Greener Graduates	Solid wall insulation	2040	-6,179	2,941	5,152	1,914
Successful Ruralites (oil)	Solid wall insulation and heat pump	2015	-5,662	5,260	15,602	15,199
Off Grid Rural Electric	Solid wall insulation	2025	-4,828	7,550	2,550	5,272

Source: Frontier Economics

If the policies are able to overcome barriers to uptake, we can see that they could entail significant social benefits, especially in relation to two consumer groups that have significant amounts to gain from low-carbon technologies ("Successful Ruralites (oil)" and "Off Grid Rural Electric").

"Off Grid Rural Electric" would have a financial benefit from carrying out these interventions even without the rebate. However, they will not take up the intervention absent the rebate, due to credit constraints.

For the other customer groups – Young Starters, Greener Graduates and Successful Ruralites (oil) – the rebate will make customers' decision to take up an energy efficient intervention cost-effective.

2.1.7 Overall conclusions

In terms of overall costs and benefits, this implies the following:

- **Stamp duty rebate.** If the policy led to the take-up of the interventions listed in **Table 1** by all consumers in those groups, we estimate that the overall benefit to the UK as a whole between 2015 and 2030 would be £5.5bn in net present value terms. £5bn of this comes from the valuation of lower carbon emissions, while a further £0.5bn would accrue from customers being able to take up bill-reducing interventions that they would otherwise not have.

- **Council tax rebate.** On aggregate, if the policy overcame these barriers for all consumers, it would potentially produce a net present value to society of around £7.9bn between 2015 and 2030 (£7.2bn of which would result from carbon savings, and £0.7bn from bill savings). The modelled maximum benefits for this policy are higher than for the stamp duty policy since it does not require consumers to move house before coming into effect, and could therefore potentially lead to consumers installing heat pumps as soon as they become cost effective, rather than when they move. However, as we have discussed in the main report, moving house is a powerful trigger to intervention installation. It is very possible that the council tax rebate, which does not tie into this trigger point, would be less effective at overcoming barriers.

- **Grants.** On aggregate, if the policy overcame these barriers, the potential maximum benefits to society would be similar to those for the council tax policy (slightly higher, to account for the fact that all households would be eligible for grants, as opposed to the 94% that pay council tax.

While **Table 1**, shows what would happen if households respond to the measures, our analysis suggests that financial incentives at this level may not incentivise uptake, even for the relatively small number of consumers identified in this modelling**.** This is because the payback for heat pumps and solid wall insulation with this level of subsidy remains above 10 years. Despite the upfront grants, these policies are unlikely to be successful in managing the upfront costs. Consumers' focus on near term costs and benefits means that few would take up measures with payback over 10 years, and businesses would be unlikely to intervene to spread the costs for them, given the barriers to offering unsecured loans over such periods.

Very radical or expensive policies would be required to ensure the payback period of the interventions listed in **Table 1** were under ten years. For example:

- **Rebates could be increased greatly. Table 2** shows that to bring the payback period down to below 10 years, for 1m solid wall interventions and

2.5m heat pump interventions (i.e. the levels which may be required to meet 2050 targets), very high subsidies would be required. The analysis shows that £25bn of subsidies for these measures alone would be required, to deliver £6.7bn of carbon savings. This estimate may be a lower bound: it is enough to ensure these technologies pay back financially for consumers, but it does not compensate them where the new heating system is associated with different performance when compared to the incumbent option. These uptake figures also assume that other barriers, such as those related to interest and awareness, can be overcome through innovative business offerings.

Table 2. Total value of subsidy required to bring payback down to 10 years and value of the carbon saved[9]

	Heat pumps	Solid wall insulation (external)
Total size of subsidy to reduce payback period to 10 years in 2020, per intervention[10]	£8k	£10k
Value of carbon savings over the lifetime of the intervention, per intervention[11]	£2k	£3k
Uptake up to 2030	2.5m	1m
Total present value of cost of subsidies for interventions installed to 2030	£16.5bn	£8.5bn
Total present value of carbon savings for interventions installed to 2030	£4.1	£2.6

Source: Frontier Economics

- **The interventions could be mandated.** This would still require policies in place (such as the Green Deal) to avert credit constraints, as well as a lower level of rebates consistent with making the interventions cost-effective (e.g. internalising the carbon price). If the rebates indicated in **Table 2** were taken up by all consumers, this would have a cost to the government of £2.7bn in net present value terms.

9 Based on DECC's carbon prices, DECC (2014), *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal*

10 This is the total subsidy required to bring the payback down to 10 years for each intervention. Further subsidy in line with the carbon price would not be required.

11 This assumes interventions are taken up in 2020. The value of carbon is calculated using DECC's non-traded carbon price.

The levels of expenditure on subsidies shown above assume that the schemes can be targeted efficiently at those properties with the most cost-effective interventions. The cost-effectiveness of interventions will depend on factors including building fabric, occupants' energy usage, and whether other interventions are installed at the same time. A failure to adequately target expenditure could lead to several types of inefficiencies.

- Subsidies for some groups where interventions are beneficial could be too low to incentivise intervention take-up, leading to an overall societal cost.
- Subsidies for some groups where interventions are not cost-effective could be too high, leading to inefficient take-up of interventions where they are not beneficial, a cost to both society and the exchequer.
- Finally, even where the subsidy leads to intervention take-up where it is societally beneficial, the subsidy could be set higher than necessary, leading to increased costs the exchequer.

Given the levels of expenditure that may be required to obtain take-up of some interventions, it is vital that any policies addressed these potential inefficiencies. This is likely to require Green Deal-type surveys.

3 Including bills in headline rent figures

This policy would require estate agents and other organisations advertising rental properties to provide a headline rental price that includes a measure of energy bill costs.

3.1.1 Counterfactual

For the purposes of modelling, we have assumed that, in the absence of a policy, tenants would not take into account the energy efficiency of a property when choosing where to rent. Evidence that this is the case is set out in annexe 2a.

As a result, we have assumed that, under the policy, there is zero take-up of any interventions.

3.1.2 Who does the policy apply to?

This policy would apply to all rented properties – potentially both those with private and social landlords. These represent 18% and 17% of the UK housing stock respectively – a total of 35%.[12]

The policy would directly impact tenants (by changing the headline rental price they saw when searching for a property). However, if the rental market was efficient, we would expect that this would lead to landlords with more efficient properties being able to charge higher rents. This would ultimately produce an incentive for landlords to install interventions.

3.1.3 How often might the policy be triggered for a household?

The policy would come into effect each time a rented property experienced a change of tenancy. Based on data from the English Housing Survey[13], around 23% of rental contracts each year are new.

3.1.4 How effective in isolation might the policy be at overcoming barriers?

We have considered how effective the policy may be at overcoming some of the different types of barriers to low carbon intervention take-up.

Find the added value for consumers, or compensate them

We have used BMET to model the interventions that might be taken up by different customer groups if the policy meant that landlords were able to take into account the energy efficiency gains of interventions. This is the same as the counterfactual uptake for the three policies above, and implies:

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12 English Houseing Survey 2012-13

13 English Housing Survey 2012-13

- take-up of HEMS Plusfor all groups; and
- take-up of cavity wall insulation for those groups that do not already have it.

Make it easier for consumers to choose low-carbon interventions

Other barriers to uptake may exist – for example, customer awareness and attention, and hassle costs. For the purposes of this modelling (and as described in the counterfactual for the financial incentive policies), we have assumed that such barriers can be mitigated for HEMS Plus and cavity wall insulation. This is since these are relatively non-disruptive interventions, which offer ongoing non-monetary benefits to consumers (particularly through enhanced levels of comfort).

Manage upfront costs

As with the policies analysed above, we have considered whether any of these interventions may have payback periods in excess of ten years. We have found that cavity wall insulation and HEMs Plus can payback within 5 or 10 years absent any other policy (see annexe 3b for further details).

Would the policy lead to energy efficiency being fully reflected in rents?

Finally, we have also considered whether the implied changes in headline rent figures would have any meaningful impact on consumer choice of property (and therefore the underlying rent that landlords could charge). Although affordability is cited as the most important factor driving tenants' choice of property,[14] tenants also consider a wide variety of non-cost factors (for example the location and size of a property). For two properties with a sufficiently small differential in price (for example, £540 per week or £544 per week), these other factors are likely to outweigh any consideration of price.

We have not attempted to model the effect of headline rent upon property choice.[15] Instead, we have assumed that a change in headline rent of less than 10% is unlikely to be sufficient to significantly affect property choice.

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14 Knight Frank, 2014, UK tenant survey 2014, private rented sector research, available at: http://content.knightfrank.com/research/707/documents/en/2014-2407.pdf.

15 One intuitive framework could be as follows: Consumers set a maximum price which they are willing to pay. They view a limited number of properties which fall within their price range, and choose the property which appeals most to them. All else equal higher prices will tend to be associated with better properties, but due to differing consumer preferences, lower-priced properties will still frequently be seen as better than higher-priced ones. The policy increases the price of some properties, and decreases the price of others. It will only affect a consumer's choice of property if their preferred property is shifted out of the price range, or a better property is shifted into the price range. As consumers can only view a finite number of properties, a small change in prices is unlikely to affect their choice.

We used BMET to calculate the expected yearly change in fuel bills from various interventions. To do this, we have combined intervention bill savings (from BMET) with average annual rent figures (statistics from Zoopla).[16] This has been carried out for a representative set of housing types and area types, for a number of interventions, including HEMS Plus and cavity wall insulation, as well as heat pumps and solid wall insulation. The figures are presented for 2025.

The results are shown in **Table 3**. For HEMS Plus and cavity wall insulation, the effect on annual bills is far below 10%. This suggests that, for these interventions, the annual bill benefits may be too small to affect consumer choice of property, and may therefore not be passed on to the landlord.

The modelling does suggest that annual bill savings may approach 10% of rent for some interventions. Among the property archetypes modelled here, these are:

- the replacement of electric resistive heating with heat pumps in flats where the rent is below central London levels; and
- the installation of solid-wall insulation for thermally inefficient rural properties.

However, these are interventions which would not be cost-effective without support from other policies, such as the rebates and grants discussed above.

16 http://www.zoopla.co.uk/property/estimate/about/

Table 3. 2025 fuel savings as percentage of annual rental price

Property type	Pre-1919 mid terrace with uninsulated solid walls		1945-1964 low-rise flats with insulated cavity walls		1965-1980 detached with insulated cavity walls		1919-1944 semi-detached uninsulated cavity walls	Pre-1919 semi-detached uninsulated cavity walls
Location	Central London	Suburban (Oxfordshire)	Central London	Suburban (Oxfordshire)	Suburban (Oxfordshire)	Rural (Moray)	Oxfordshire	Rural (Moray)
Average annual rent	£183,082	£19,558	£62,089	£15,018	£36,917	£10,175	£21,918	£6,016
Heating type	Gas boiler		Electric storage		Gas boiler		Gas boiler	
Insulation saving	0.2%	1.4%	Already insulated to a sufficient standard		Already insulated to a sufficient standard		1.2%	9.5%
HP saving	This property cannot install HP without insulation upgrade		2.1%	8.6%	-0.2%	-0.8%	This property cannot install HP without insulation upgrade	
Insulation + HP saving	0.1%	1.1%	-	-	-	-	0.9%	8.6%
HEMS Plus saving	0.0%	0.4%	0.2%	1.0%	0.1%	0.5%	0.3%	1.2%

Source: Frontier Economics

3.1.5 If the policy overcomes barriers, what effect does it have?

As described above, the policy we have modelled is unlikely to overcome barriers to intervention take-up for a large proportion of households.

- For HEMS Plus and cavity wall insulation, the modelling indicates that the bill reductions are a small proportion of annual rent. It seems unlikely that these would be passed on fully to landlords. The BMET modelling used a relatively small number of customer groups, and it does seem plausible that there will be some households where affordable measures such as cavity wall insulation do lead to a material decrease in bills compared to rent. Nevertheless, these may account for a relatively small proportion of the overall stock of rented houses.

- For interventions with greater up-front costs and correspondingly greater bill savings, landlords will still not have a positive net present value from investing, due to the absence of a carbon price or similar measure.

3.1.6 Overall conclusions

On its own, this policy is likely to be of limited effect, since it does not directly tackle other barriers to take-up. However, in combination with other policies that deal with these barriers, it may be an effective way of ensuring take-up of high cost / high benefit interventions (such as heat pumps in electric resistive properties) in the rental market.

It should also be noted that this policy would involve relatively low direct costs to Government. It may therefore be worthy of further consideration alongside other measures, despite the relatively small effect it may have on its own.

4 District heat regulatory measures

Our package of measures for district heat consists of four measures.

- **Grants to developers of district heating** to reflect the carbon savings associated with district heating relative to current heating;

- **A regulatory framework to license developers**, formalising competition for the market (e.g. through tender processes to develop heating networks with local authorities) by licensing developers and awarding them a local monopoly;

- **Risk sharing between government and developers.** This could be combined with licensing, as a license could specify risk sharing between the government and developers, for example which types of risks government takes on, and conditions for government providing resources. The types of risks that government may be best placed to manage include providing long-term heat demand guarantees or loan guarantees; and

- **Ex-ante regulation of district heating to protect consumers** in relation to pricing and quality of service (which could also include quality assurance of installations). Formal ex-ante regulation is already widely used in other natural monopoly sectors.

We now consider the potential impacts of these measures quantitatively and their costs.

4.1.1 Counterfactual

District heating currently meets 2% of UK heating needs.[17] There are currently around 210,000 homes connected to around 2,000 district heating networks.[18] Data on the exact scale of development of further district heat networks is limited. Current estimates are that 150 district heating schemes are in development by UK local authorities.[19] Assuming heating networks currently under development are of the same scale on average as existing networks, this could imply a maximum of 16,000 additional households connected in the near term if all the heating networks being developed by local authorities are completed. This figure represents an upper limit, however, given that some district heating networks in the early stages of development will not go ahead.

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17 DECC (2013) *The Future of Heating: Meeting the challenge*

18 DECC (2013) *The Future of Heating: Meeting the challenge*

19 https://www.gov.uk/government/news/94-million-to-boost-low-carbon-heating

Research undertaken for DECC estimated that if current policy remained in place, no further take up of district heat would occur by 2030.[20]

4.1.2 Who does the policy apply to?

The policy measures we are considering would affect:

- all consumers connected to new district heating networks in the case of grants, licensing and risk sharing arrangements; and
- both all existing and all new district heating consumers in the case of ex-ante regulation.

4.1.3 How often might the policy be triggered for a household?

The policy measures would be triggered for households every time they connect to a heating network, on an ongoing basis. Regulation of district heating would apply to all households connected to district heating (whether new networks or not), on an ongoing basis.

4.1.4 How effective in isolation might the policy be at overcoming barriers?

Risk sharing between district heating developers and government is expected to increase take up of district heating, by reducing the risk for developers, but this will only be effective if combined with other interventions. Research for DECC considered the impact of reducing the risk to developers, so that the required rate of return they faced fell from 10% to 6% (in real terms). This found that, with no other changes in policy, district heating would meet none of the UK's heating needs by 2030.[21] A further reduction in the required rate of return, to equal the social discount rate, was found to result in district heat take up reaching 3% of UK heat demand by 2030.[22] We summarise the results of these scenarios in **Table 4** below.

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20 This assumes investors apply a 6% discount rate in their decision making. Pöyry and Faber Maunsell (2009), *The potential and costs of district heating networks, A report to the Department of Energy and Climate Change*

21 I.e. take up of district heating would have fallen to zero by 2030 relative to the current situation.

22 Pöyry and Faber Maunsell (2009), *The potential and costs of district heating networks, A report to the Department of Energy and Climate Change*

Table 4. Estimated district heating as a proportion of UK heating needs in 2030

Discount rate	Assuming current policies continue	Assuming a carbon price is in place
10%	0%	0%
6%	0% if no capital cost reduction 3.1% with a 20% capital cost reduction	0.6%
3.5%	3.2%	5.8% - 13.9%

Source: Pöyry and Faber Maunsell (2009), *The potential and costs of district heating networks, A report to the Department of Energy and Climate Change*

Note: all estimates assume no capital cost reduction, unless stated otherwise

The estimates illustrate that reducing risk faced by developers is important for driving take up, but that take up will be low if risk is addressed in isolation from other barriers. Estimates of the costs of risk sharing to government are not available. Many of the costs are likely to fall on local authorities, given that they are well placed to manage many of the risks associated with heat network development (e.g. planning, or long-term heat demand from public buildings). We discuss the barriers and risks further in annexe 2a.

Reducing the costs of district heat for developers is also a key driver of take up, but only where this is combined with risk reduction. The analysis for DECC finds that, under current policies (i.e. without an economy-wide carbon price), a reduction in capital costs of 20% is estimated to result in higher take up of district heating only when also considered alongside a required rate of return of 6% (or lower), rather than 10%. The resulting take up is 3% with a 6% required rate of return and a 20% capital cost reduction (see **Table 4** above). Similarly, reducing the required rate of return from 10% to 6% has no impact on take up in the absence of reduced capital costs. This suggests that high risk and high costs should be addressed jointly, and that there is a role for resource provision by government in conjunction with risk sharing to drive development.

Pricing the carbon externality is also important. Projected district heating take up with a carbon price is zero in 2030 at a 10% required rate of return, as in the case where there is no carbon price but current policies remain in place.[23] However, at a 6% required rate of return, take up is 1% of UK heat demand (compared to

23 Pöyry and Faber Maunsell (2009), *The potential and costs of district heating networks, A report to the Department of Energy and Climate Change*

zero at a 6% rate at current policies), and 6-14% of UK heat demand at a 10% rate of return (compared to 3% at current policies). See **Table 4** above. This assumes no cost reduction.

Based on the estimated carbon savings associated with district heating, we estimate that a grant paid to district heating developers would need to be between £1,960 and £9,802 to internalise the greenhouse gas externality. Our estimates are set out in **Table 5**.

Table 5. Estimated grant required for district heating developers to internalise the carbon externality

	Annual carbon saving per household of district heating relative to baseline (T/CO2)	Net present value of carbon saving (£)
Low	1	£1,960
High	5	£9,802

Source: Estimated carbon savings from Pöyry and Faber Maunsell (2009) for DECC, and carbon prices from DECC

Note: Assumes a 25 year lifetime and a base year of 2025. Projected central non-traded carbon price applied in estimates.

The impact of ex ante regulation of district heating is also likely to be beneficial for consumers. Evidence from countries with unregulated district heating networks shows that outcomes can be adverse in the absence of ex-ante regulation. There have been repeated competition investigations in Sweden, and an ongoing investigation in Germany. The investigation in Germany indicated that some DH consumers pay less than 4c/kWh, with others paying more than 18c/kWh.[24] This has resulted in the German Federal Cartel Office instituting proceedings against seven district heating suppliers on suspicion of their charging abusively excessive prices.

4.1.5 If the policy overcomes barriers, what effect does it have?

Current take up of district heating is small relative to estimates of potential take up in the domestic sector if barriers are overcome. DECC estimates the potential for district heating in the UK of around 14% by 2030.[25]

The estimates that we have analysed suggest that, without a carbon price, the policies will result in increased take up of district heating, with regulation also improving and/or safeguarding outcomes for consumers. However, the estimated impacts of risk sharing result in increased take up to levels that are nonetheless substantially below the estimated potential of 14% take up by 2030. If a grant is set equal to the equivalent carbon price, then this, combined with substantial risk reduction, could result in take up of 6-14%. Given the requirement for a high density of heat demand, district heating is most suited to urban areas, so we would expect take up to be concentrated amongst urban consumers.

4.1.6 Overall conclusions

To deliver district heat, it may be most effective to introduce a package of measures including grants to internalise the carbon cost, licensing to encourage developments and risk sharing to address network issues and high sunk costs, and regulation to protect consumers.

25 The paper estimates take up of district heat of 6-14% of UK heat demand where a carbon price equal to the shadow price of carbon is introduced and a 3.5% discount rate is applied. Pöyry and Faber Maunsell (2009), *The potential and costs of district heating networks, A report to the Department of Energy and Climate Change*

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