Heating our homes – Phasing out fossil fuels

A policy pathway to developing a viable heat pump market

Contents

The opportunity to revolutionise off gas grid heating..... 4

Trigger points..... 7

New build homes today 7

Why is the building of the home so important to meeting our carbon targets? . 8

What is a future-proofed home?..... 9

Recommendations 11

Achieving the phase out in existing homes 12

What barriers exist to the adoption of heat pumps? 12

Overcoming the cost barrier and recognising the value of low carbon heat.....13

Energy Company Obligation 13

Building regulations for retrofit.....14

Renewable Heat Incentive successor policy 16

Timeline of recommendations 18

References 19

NIBE Energy Systems Limited

Unit 3C Broom Business Park, Bridge Way, Chesterfield, S41 9QG

Email: info@nibe.co.uk Website: http://www.nibe.co.uk/

Clean Growth – a policy gap

Under the Climate Change Act 2008[1], the Government is required to publish its proposals and policies that will enable carbon budgets to meet the 2050 target of reducing carbon emissions by 80% on 1990 levels. The Clean Growth Strategy[2], published October 2017, sets out these with the aim of accelerating the pace of "clean growth". The publication of the Strategy is an important milestone as it sets out a framework for future action.

In the Clean Growth Strategy, the Government has committed to phasing out high carbon fossil fuel heating in new and existing homes currently off the gas grid during the 2020s, starting with new homes. To stay on track to the 2050 target and to maintain the UK's contribution to the Paris Agreement, the emissions from heating and hot water in UK buildings must be largely eliminated[3]. As shown in the graph below, the proposals and intentions within the Strategy are expected to help to reduce emissions and thus the policy gap, however the Committee on Climate Change state that even if these ambitions are delivered in full, a gap would remain (highlighted in red). This means that phasing out high carbon fossil fuels in off grid homes is required as a minimum.

Therefore, it is key that the Government now delivers on its Clean Growth Strategy pledges with tangible policy recommendations; anything else would be a blow to low carbon heating investment in the UK. This paper by NIBE, the leading heat pump manufacturer in Europe, sets out policy recommendations on how to achieve a transition from fossil fuels to renewable heating technologies off the gas grid using learnings from other European markets that have been more successful in this domain.

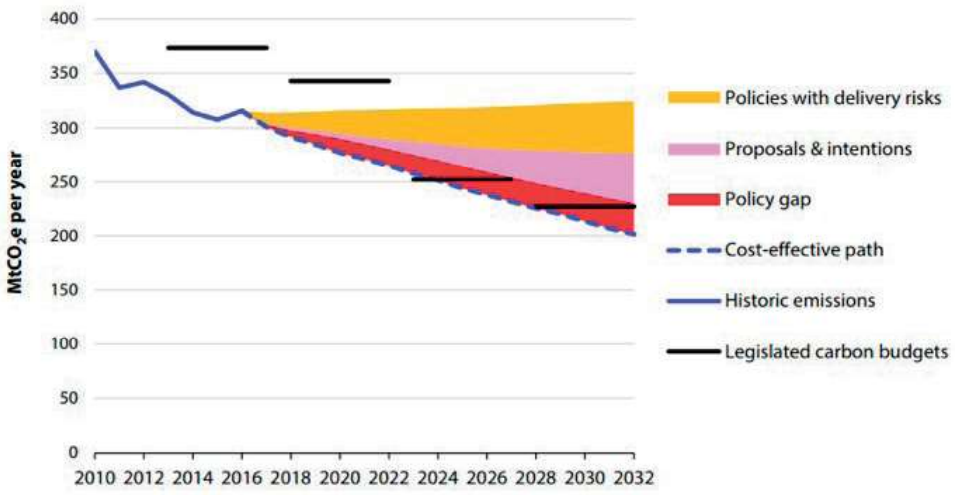


Figure 1 – Committee on Climate Change – Policy gap assessment following Clean Growth Strategy[4]

The opportunity to revolutionise off gas grid heating

It is estimated that 13.9% of households in Great Britain are not connected to the gas grid[5] (3.3 million homes[6]). If the heating mix of these properties was left unchanged, it is estimated that the cumulative emissions between 2017 and 2032 would be 235.9MtCO_2e which equates to 3.8% of the carbon budgets for same period. The graph below shows the impact of business as usual on annual carbon emissions off gas grid. The decline in emissions primarily comes from the electricity grid carbon intensity falling.

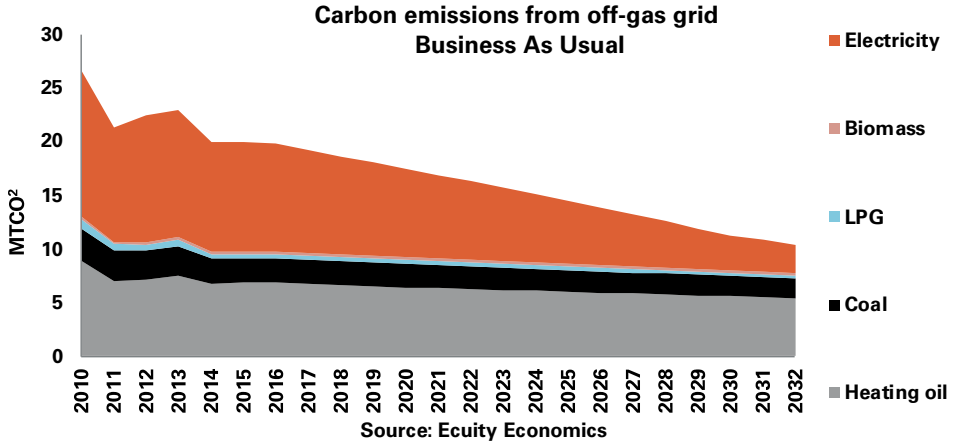


Figure 2 – Carbon emissions from off gas grid homes. Business as usual scenario

The Government has committed to phasing out high carbon forms of fossil fuel heating in these homes. This means targeting households using oil in particular, of which there are 1.8 million in the UK[7]. The heating of the 850,000 homes in England by oil in 2013 resulted in 8MtCO²e. Phasing out the use of high carbon fuels represents a significant opportunity for decarbonisation however, historically the heating mix in off grid homes has remained largely stable and therefore it is likely that this mix will continue without impactful policy.

The Department for Business, Energy and Industrial Strategy (BEIS) has stated that the phase out in new and existing homes will occur during the 2020s, starting with new build. The timing of the phase-out is uncertain and at present there is a lack of policy to stimulate a transition away from oil and coal to low carbon heating systems.

Below we have modelled the impact of phasing out high carbon fuels as soon as possible and delaying the phase out until the late 2020s in existing homes. The analysis assumes that households using these fuels switch primarily to heat pumps as shown by the dark red sections. Switching from high carbon fossil fuels to heat pumps is possible and cost effective with most of our clients making this transition. The main motivations for the switch are cost savings followed by increased reliability and sustainability or carbon reduction.

Heat pumps: the solution

Heat pumps are a proven technology and have seen successful deployment in other European countries.

Heat pumps are highly efficient and have no emissions other than those associated with the production of electricity which as shown above is expected to continue to decline.

When designed and installed correctly, heat pumps can deliver heat to almost any building in the UK regardless of size. The key to ensuring that a heat pump runs effectively is ensuring that the distribution system is configured correctly. Heat pumps work most effectively at lower temperatures around 50°C compared to 80°C for a traditional boiler. Heat pumps are designed to run for longer periods of time providing a steady heat supply rather than short cycles. The lower temperature and steady supply of heat means that they are well suited to accompany underfloor heating solutions. Heat pumps can also be very effective when installed with appropriately sized radiators even in inefficient properties.

Our heat pumps are installed with smart technology making them easy to control and enabling dynamic response to energy prices. Heat pumps provide a consistent level of heating and as this varies from traditional heating systems, consumers will need to adapt their heating habits. The steady delivery of heat makes the living environment very comfortable and reduces the risk of homes being overheated.

Heat pumps have longer lifespans than traditional boilers, in particular ground source heat pumps. An air source heat pump has a lifespan of over 15 years and a ground source heat pump can last over 20 years compared to a gas or oil boiler of which has an average lifespan of 12 years. This means that whilst heat pumps are likely to cost more to install, the savings are significant enough to cover this cost and provide consumers with reduced energy bills thus saving them money long-term.

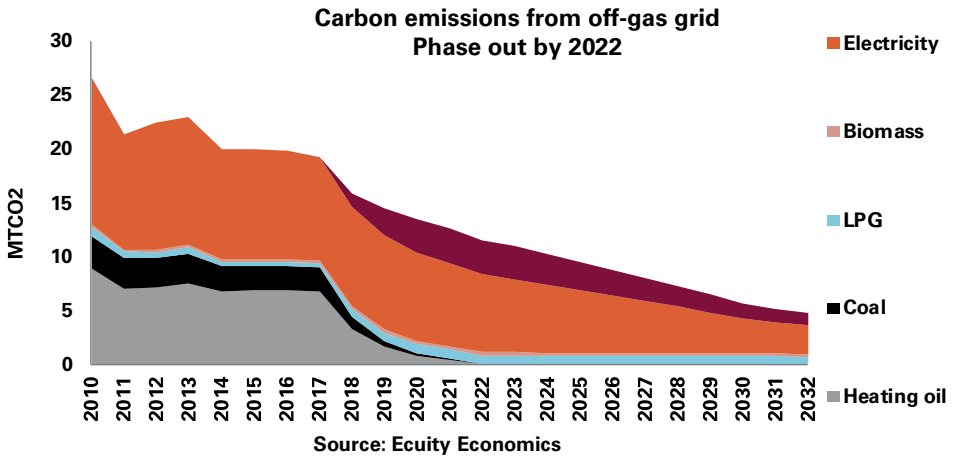


Figure 3 – Carbon emissions from off grid homes: Phase out by 2022 scenario

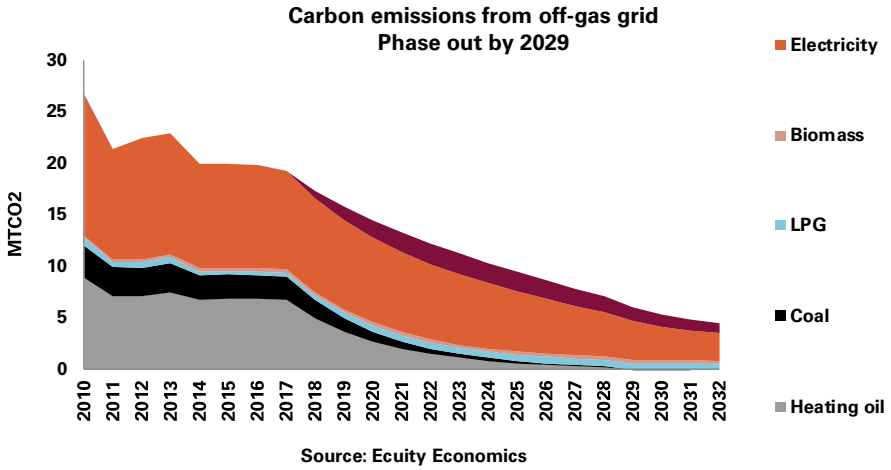


Figure 4 – Carbon emissions from off gas grid homes. Phase out by 2029 scenario

Phasing out high carbon fuels during the 2020s is essential if the UK is to meet its carbon targets. The impact of phasing out oil is approximately a 30% reduction in carbon emissions from heating our homes. The cost of not phasing out high carbon fossil fuels early and delaying the phase out in all homes to 2029 in terms of carbon emitted is 3.16MtCO_2e. In addition, moving away from high carbon fossil fuels to heat pumps offers significant benefits in terms of air quality too.

The Committee on Climate Change[8] (CCC) has welcomed the commitment to phase out high carbon fossil fuels. The phase out is comparable to their Central Scenario for meeting the fifth carbon budget in which heat pumps and biomass are installed to replace oil, coal and LPG heating. In this Scenario, the CCC predict that the deployment of 2.3 million heat pumps in homes by 2030 is the minimum that is needed to ensure the deep decarbonisation of heat in buildings in 2050. This is split into 1.1 million heat pumps in existing homes and 1.2 million in new build properties.[9]

Whilst the Strategy puts forward the phase out of high carbon fuels in off grid properties as a priority, it does not outline how it will achieve this ambition. In order to phase out heating oil, the Government will have to regulate its removal at some point during the 2020s, however in the interim a number of steps can be taken to encourage the transition;

1. A concrete date for heating oil phase out must be set; the sooner the better to provide certainty
2. Low carbon heating must be deployed in buildings capitalising on key trigger points
3. The groundwork for widespread uptake must be set; this means ensuring homes are renewables ready, consumers are aware of the options available to them and installer numbers increase

Trigger points

It is important that the efforts to achieve this ambition are focused on the key trigger points for heating system replacements. In a market survey, initiated by NIBE and focused on installers[i], we found that for two thirds of respondents, the main reason for a heating system replacement is a major refurbishment or a new build project (see Figure 5). With 80% of respondents stating that property development, major refurbishment or faulty systems are the primary triggers for consumers to opt for a heating system replacement, policy should focus on targeting these instances.

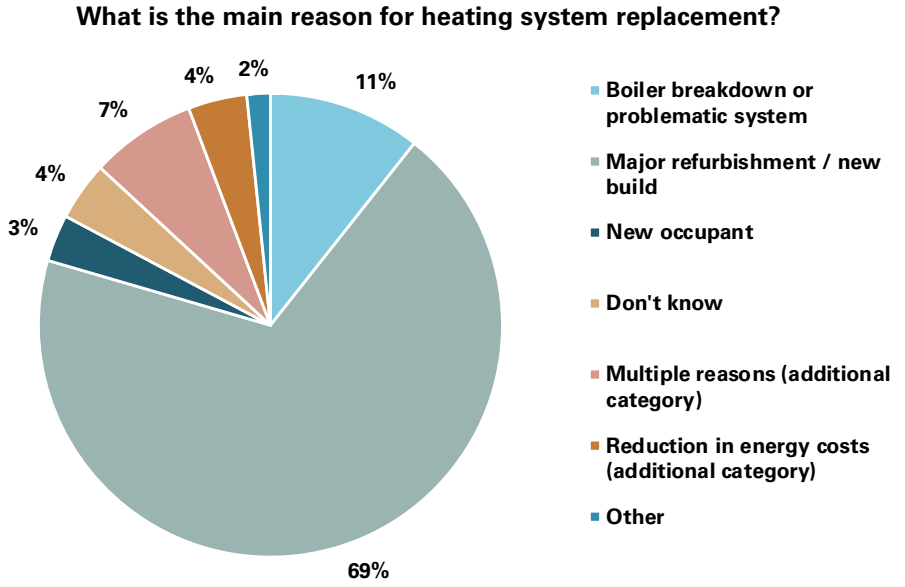


Figure 5 – NIBE installer survey- Question: What is the main reason for heating system replacement?

This report will provide proposals to introduce new policies or amend current policies to enable the timely phase out of high carbon heating. The three key trigger points will be discussed in more detail and we will explore how policy can be used to encourage the uptake of low carbon heat and ensure that homes are future-proofed.

New build homes today

Between 2001 and 2010, there were on average 144,000 new homes completed annually in the UK, 100,000 fewer than in the 1970s, yet the population has risen[10]. The Government is committed to building 225,000 to 275,000 more homes per year to keep up with population growth. House building in the UK is seeing the fastest growing output ever recorded; over the last 4 years there has been a 74% increase in supply. This commitment to build more homes is both an opportunity to provide warm, affordable and healthy homes and a challenge as there is a risk that quantity could prevail over quality.

In the rush to build more homes and ensure that they are affordable to buy, it is important that policy also drives up quality and supports the deployment of low carbon heat. Sustainable, high quality and healthy homes can be built quickly and must not only be affordable to buy, but also be affordable to live in while also costing homeowners less to upgrade to a low carbon heating system in the future.

[i] *In 2017, NIBE Energy Systems surveyed 137 individuals on their views of the heat pump installation market. The survey targeted installers with over 50% of respondents identifying themselves as installers.*

A very small proportion of new build properties are heated using oil. BEIS estimate that around 1% of new homes have oil boilers. The EPC register indicates that this figure could be higher, however the number of properties with oil fired heating is low.

Whilst phasing out oil in new build properties is welcomed, policy should go further and encourage the installation of clean, renewable heating solutions in the place of fossil fuels. Currently, homes are built to meet a minimum SAP requirement which can mean that additional energy saving, and renewable heating measures which could lower energy bills and reduce carbon emissions further are not considered. Whilst it is appreciated that not all properties will have a renewable heating system today, if renewable heating systems are not installed, for example in homes connected to the gas grid, homes should be built to a future proofed standard. If new homes are inefficient, do not enable allow low temperature heating systems and are reliant on fossil fuels, they will need retrofitting. This can be costly, both for the consumer and for carbon abatement.

The government has recognised this and has stated that we "need to avoid new homes needing to be retrofitted later and ensure that they can all accommodate low carbon heating. This could involve all new homes off the gas grid from the mid-2020s being heated by a low carbon system such as a heat pump."[11] It is important however to ensure that homes on the gas grid are also future proofed for low temperature heating so that all heat strategic options remain open.

Why is the building of the home so important to meeting our carbon targets?

As noted above, 18% the UK's emissions come from buildings and by 2050 we will need to have an almost decarbonised building stock. Homes built today will last long into the second half of the century and it is paramount that they do not add further to the decarbonisation challenge. With a required new build rate of 275,000 homes per year, building to current standards is just not an option if we are to meet the 2050 target.

Building a home is the cheapest and easiest time to get the building fabric, ancillary measures and heating system right. Not only is it easier to install the heating system during construction, integrating heat pumps into the design of a property improves the overall efficiency of the system and reduces costs[12]. New build developments benefit from economies of scale, which means that both purchase and installation costs are reduced as products are bought in bulk and the tradespeople are onsite. Installing a heat pump in a new build development is significantly cheaper per property compared to retrofitting a system as a one-off project.

Energy efficiency is the most cost effective and long-term solution to ensuring that the emissions from our housing stock are reduced. New build homes are more thermally efficient than ever before, and heat losses have been greatly reduced. Not only do consumers realise the benefit of warmer, more comfortable homes, properties with a lower energy demands require a smaller capacity heating systems, again lowering the cost of purchase and installation.

Heat pumps perform best in properties with higher thermal efficiency due to the low temperature at which they operate. This means that they are the ideal solution to providing heat to new build homes, particularly off the gas grid. Lower temperature requirements can be easily met during the building design process, for example underfloor heating or larger radiators can be installed without significant additional investment.

In addition, at the point of build, many of the barriers to renewable heat installation faced by owner occupiers and landlords are removed. For example, the property is not occupied so there is no disruption for the owner. The hassle associated with any major refurbishment can be a significant barrier for consumers and can often prevent them taking action to improve their homes. So, ensuring that homes are built to a high standard with low carbon emissions will significantly reduce the impact of them over their lifetime and will reduce the need for consumers to carry out future costly retrofits.

What is a future-proofed home?

The Government is committed to 'ensuring new homes in England are futureproofed for the installation of lower carbon heating systems where this is cost-effective, affordable and safe to do so'[13]. In terms of heating, a future proofed home could be one which is fitted with an efficient, low carbon heating system or one which is able to easily accommodate such a system in the future. The following building characteristics help to ensure that a home can adopt low carbon heat in the future and that its impact today is minimised:

- High thermal performance and thus low energy demand for heating
- Heating systems that operate at low flow temperatures
- Low temperature heat emitters
- Inclusion of or space to install thermal storage

Liquefied Petroleum Gas (LPG) is considered to be the main alternative fossil fuel system to oil fired systems in off grid areas. While this may reduce carbon emissions (carbon intensity of LPG is lower than heating oil[ii]), the running costs will increase. It is anticipated that with a phase out of oil, LPG systems will be installed more frequently. Assuming that the proposal to ban oil installations in new build is introduced, we have modelled two scenarios:

1. A new build property (off-gas grid) is heated initially using an LPG boiler. This is replaced by an air source heat pump (ASHP) at the end of the boiler's lifetime.
    - This Scenario (1) assumes that the new build standards require properties to be highly energy efficient and able to accommodate a low carbon heating system, such as a heat pump in the future. The LPG boiler is replaced with a heat pump at a later date at the current market rate.
2. A new build property (off-gas grid) is heated initially using an ASHP. This is replaced by another heat pump at the end of its lifetime.
    - This Scenario (2) assumes that the new build standards require properties to be highly energy efficient and fitted with a heat pump. The heat pump is then replaced. The replacement system has benefited from a learning rate due to economies of scale and mass market adoption.

Our modelling shows that by recommending the use of ASHPs in new builds today, households could save £1,653 (discounted) in running costs compared to using an LPG boiler. The total running cost of Scenario 2 is £3,427 whilst the total running cost of Scenario 1 is £5,080. Figure 7 models a 12-year period as this is the lifetime of an LPG boiler and running cost comparisons can be made.

[ii] *Carbon intensity of heating oil (kerosene) is 0.245kgCO_2/kWh compared to 0.214kgCO_2/kWh for LPG* (BEIS conversion factors)

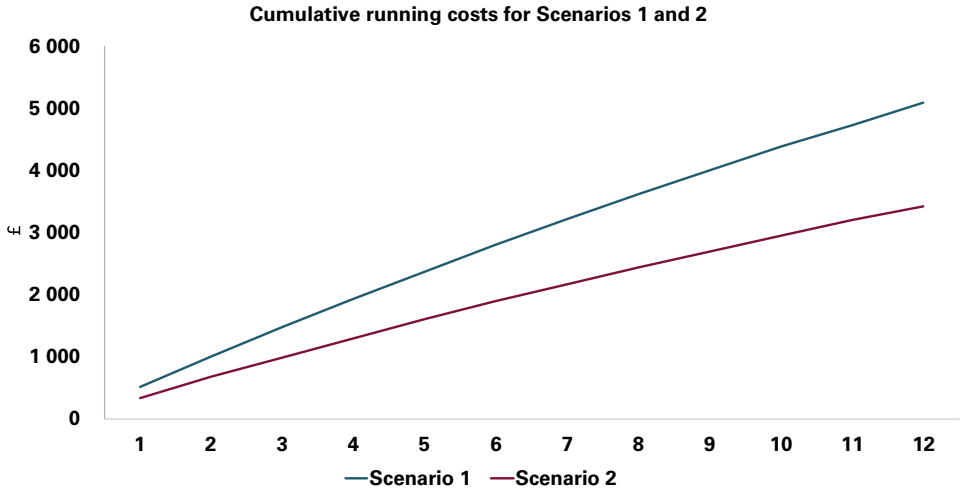


Figure 6 – Cumulative running costs from Scenario 1 and Scenario 2 (Source: Ecuity Consulting LLP)

When modelling the total cost (both operating and capital cost), Scenario 2 saves households on average £277/year relative to Scenario 1 until the household replaces the LPG boiler with an ASHP (after which the savings are equalised). This demonstrates that despite the higher capital costs associated with installing an ASHP, the annual operating cost savings are high enough to offset this and provide the consumer additional ongoing savings.

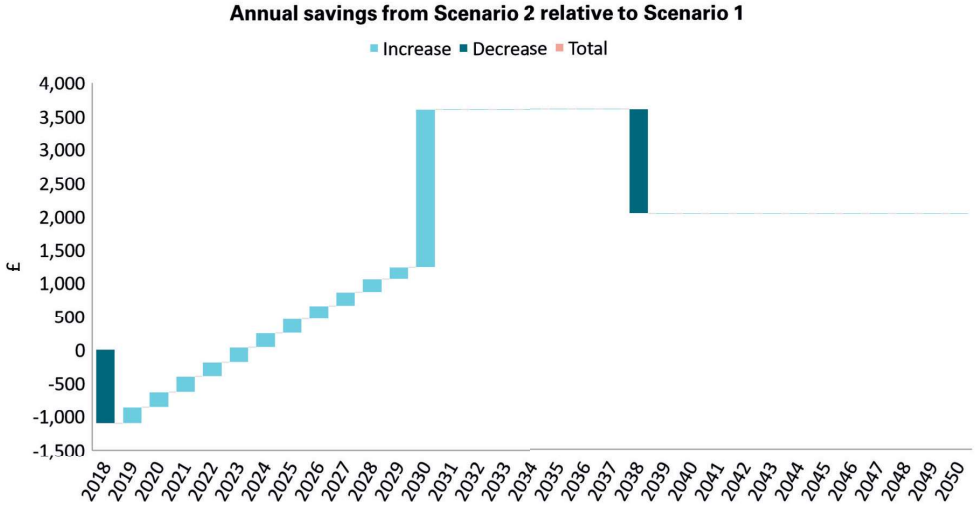


Figure 7 – Annual savings from Scenario 2 relative to Scenario 1 (Source: Ecuity Consulting LLP)

The chart above shows the discounted annual savings of choosing Scenario 2 relative to Scenario 1.

The model assumes that in Scenario 1 the LPG system is replaced in 2030 with a heat pump. In line with the longer expected lifetime of a heat pump compared to an LPG boiler, the heat pump installed in Scenario 2 is replaced in 2038.

The dark blue bar of £1,100 in year 2018 represents the price difference between a heat pump unit and LPG boiler, with the former being relatively more expensive. The significant saving in 2030 is the avoided cost of installing a heat pump to replace the LPG system (£2,356). The dark blue bar in 2038 (£1,558) is the discounted cost of installing an ASHP replacement in a future-proofed home. From 2031 onwards, both scenarios are using an ASHP, so the relative savings are zero.

Under Scenario 1, total carbon emissions between 2018 and 2050 amount to 23 tonnes of CO_2 per household. Under Scenario 2, total carbon emissions over the same period amount to 8 tonnes of CO_2. Recommending Scenario 2 yields a 65% saving in carbon emissions. With a required new build rate of 275,000 homes per year, recommending Scenario 2 would save the economy 4.2MtCO_2 by 2050. When monetised, £308 million could be saved over the same period in abated CO_2 costs.

The lifetime net present values of each scenario are presented below. The capital costs in Scenario 2 were slightly higher due to the fact that the ASHP is more expensive than an LPG boiler. However overall, Scenario 2 yielded a lower NPV (£11,942) driven by lower lifetime operating costs.

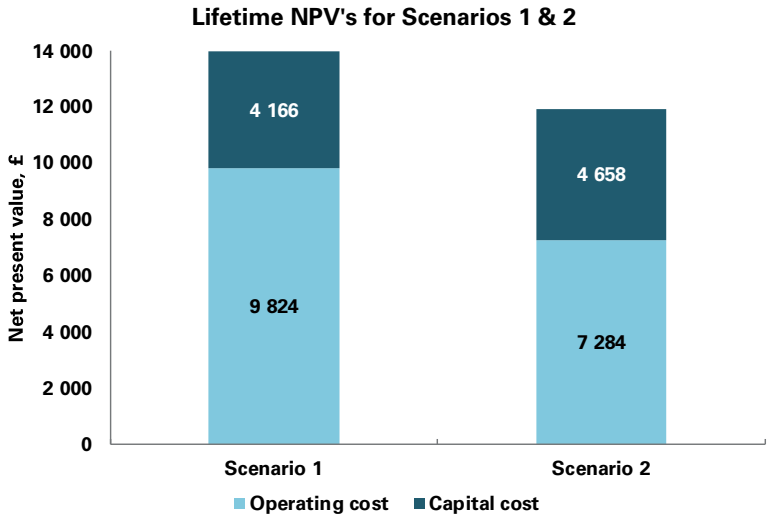


Figure 8 – Lifetime NPV (Source: Ecuity Consulting LLP)

On the whole, we strongly recommend mandating Scenario 2 – installing an ASHP now and then replacing it at the end of its lifetime. This is because there are significant annual savings for the consumer and the lifetime NPV is lower too. While the capital costs may be slightly higher under Scenario 2, the lower operating costs are enough to offset this and overall lead to lower total costs for the consumer.

If properties are built to a future proofed standard, then the cost of installing a heat pump in the future is greatly reduced as heat emitters are appropriately sized. A future proofed heating system, running at a lower temperature, saves consumers money on their energy bills and ensures that the system operates efficiently. If a home built today does not feature a renewable, low carbon heating system, it will require a retrofitting in the future. This adds additional cost to the consumer and delays the UK's progress towards achieving the carbon targets. Encouraging house builders to consider low carbon heating systems today will provide a net benefit to the UK.

Recommendations

To achieve the ambition of phasing out fossil fuel heating in off gas homes, new homes will need to be built with heat pumps or alternative low carbon heating when built off the gas grid.[14] In these off the gas grid locations, we believe that low temperature heat pumps should be the technology of choice for new homes.

The central Scenario, which is the CCCs best assessment of the requirements to meet the budget, states that by 2025, half of all new builds will be fitted with a heat pump and by 2030 all new build house sales should incorporate heat pumps. This will not only reduce carbon emissions from the off-grid building stock, it will also help to build scale, increase

confidence in the market and reduce installation costs. These benefits will be passed onto the retrofit market where additional efforts are needed to reduce emissions and switch consumers to low carbon systems.

To achieve the recommended deployment rates by 2025, policy will need to play a key role. The building regulations are the primary driver for the adoption of specific technologies in new build properties. The Building Regulations are due to be consulted on in 2019, offering a significant opportunity to improve the standard of new homes and reduce emissions from our building stock. It is recommended that through building regulations:

- The installation of high carbon fossil fuel heating is prohibited
- Low carbon heating systems are mandated in off grid areas
- Where fossil fuel heating systems are installed, these should be low temperature ready
- The maximum dwelling emission rate (kg CO_2/m^2) is reduced over time to encourage continuous improvement

Achieving the phase out in existing homes

What barriers exist to the adoption of heat pumps?

Support for the use of renewable energy is increasing[16]; over two-thirds of people are aware of renewable heating systems and of these 57% are aware of air source heat pump technology. Despite the high proportion of the population who are aware of renewable heating systems, only 3% of respondents to the Energy and Climate Change Attitude Tracker had installed a system at home. To encourage greater uptake of heat pumps in homes and understand why this awareness does not convert into increased uptake, it is important to consider the barriers consumers face.

The Attitude Tracker[17] found that whilst there is an awareness of renewable heat, a large proportion of the population have a lack of knowledge of renewable heating systems. It found that 63% were unsure as to whether renewables would heat the home better than the current system, 64% stated that they did not know whether renewables would be more or less reliable than a conventional system and 55% of people did not know whether they would be cheap to run or not. Our market survey[iii] echoes these findings, with 17% of respondents highlighting a lack of awareness, knowledge and understanding as the primary barriers to heat pump deployment. It is therefore important that independent reliable advice is made available to consumers to help increase awareness and understanding.

Our market survey asked respondents what the single biggest barrier was to heat pump installation. In response to that question, 43% stated that cost was a major barrier (see Figure 9). This corresponds to the findings of the Energy and Climate Change Attitude Tracker with 25% of respondents stating that renewable systems would cost too much to install.[18] Below we review three potential policy areas that could help to address this barrier.

[iii] *In 2017, NIBE Energy Systems surveyed 137 individuals on their views of the heat pump installation market. The survey targeted installers with over 50% of respondents identifying themselves as installers.*

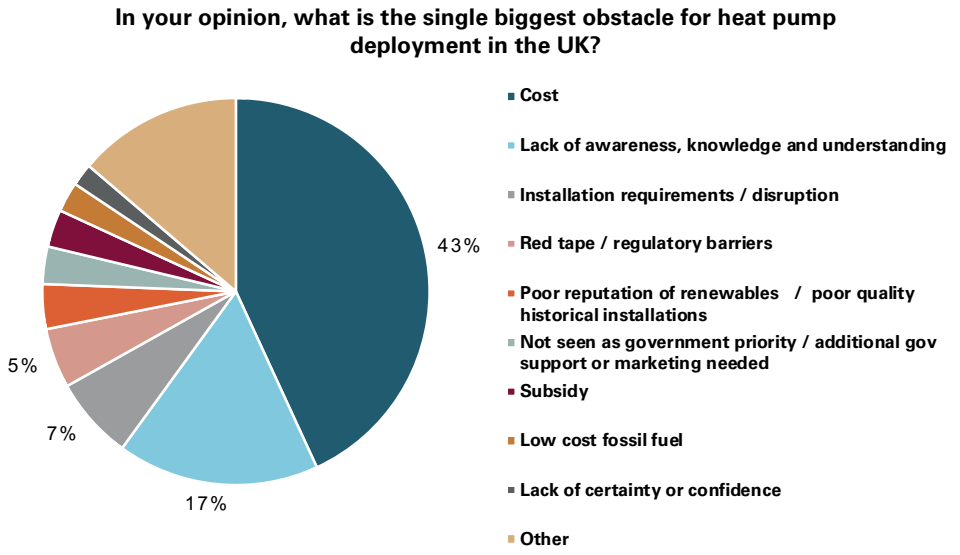


Figure 9 – NIBE Market Survey: Single biggest barrier to heat pump deployment

Overcoming the cost barrier and recognising the value of low carbon heat

The relative high capital cost of renewable heating systems compared to conventional fossil fuel systems is a significant barrier for many homeowners. In addition to the higher cost, the installation of low carbon heat and the subsequent improvement in energy performance rating is not recognised in the value of a property. As such homeowners lack the incentive to install more efficient, lower carbon systems. Below we discuss how the Energy Company Obligation (ECO), Renewable Heat Incentive (RHI), Building Regulations and market-based mechanisms can be used to enable and encourage the adoption of renewable heating systems.

Energy Company Obligation

Energy Company Obligation (ECO) phase 3 primarily targets fuel poor households. The prevalence of fuel poverty is greater in off gas grid properties due to the reliance on expensive fuels and the poor thermal performance of many of these homes. On average 14% of households in rural villages, hamlets and isolated dwellings are classified as fuel poor compared to 11% in urban areas[19]. These households are faced with limited options to heat their homes and the properties are often cold, inefficient and expensive to heat.

As a result of the high deployment of oil boilers under previous iterations of ECO, BEIS proposed a cap on broken boiler replacements. This proposal was aligned with the Government's commitment to phase out oil heating in homes during the 2020s. However, following a public consultation, the Government announced that it would allow the installation of oil boilers under ECO3 despite the fact that this is the one area of the heating market where the level of financial support available means that the home occupant (end-user) may be more amenable to switching to an alternative heating solution due to reduced cost barriers. The Obligation should instead be aiding low income households with broken oil boilers in ways that are consistent with the Clean Growth Strategy.

The Government has stated that ECO funding cannot be combined with RHI support except in the case where a ground source heat pump is installed. Whilst the ability to combine ECO and RHI funding for ground source heat pumps is welcome, the scheme should not be prescriptive in regard to the low carbon heating solutions supported. ECO should be supporting a wide range of technologies including ASHPs which could offer a cost-effective heating solution for many rural fuel poor households. Restricting the funding means that there is a risk that fuel poor households may be left without a means to heat their home and very few options available to them, especially if the broken boiler cap is approached. Enabling the unrestricted use of RHI alongside ECO would allow fuel poor households an opportunity to access low carbon, future proofed heating systems – something they would not have access to without ECO support due to the higher upfront cost associated with low carbon systems. If support is not given to low income households to transition to renewable systems, the cost associated with decarbonising the building stock will be significantly increased and may be passed onto vulnerable consumers.

Building regulations for retrofit

The majority of homes have central heating systems with the most common fuel type being gas. Building regulations have acted as a powerful driver towards improved efficiencies in homes on the gas grid. This was demonstrated by the regulatory change to mandate the installation of condensing gas boilers in 2005.

The introduction of the Boiler Plus[20] policy provides a first step towards low carbon heating systems in homes on the gas grid. However, more needs to be done to widen the range of heating systems included and enable the transition to renewable systems. The installation of a replacement heating system is the ideal time to prepare the home for the next generation of heating.

Heat pumps operate at a lower temperature than conventional heating systems such as oil or gas and this means that they often require larger or low temperature heat emitters to deliver the appropriate flow temperatures to ensure the heat pump's efficiency. However, lowering the flow temperature of a conventional heating system can also offer significant savings in heating costs. Today installers of fossil fuel heating systems are not required to replace or upgrade heat emitters as part of the installation process. However, in the majority of cases during heat pump retrofit scenarios, the heat distribution system e.g. radiators need upgrading as they are not suitable for a low temperature system (see Figure 10 below).

It is possible to reduce the future cost of heat pump adoption by encouraging to upgrade heat emitters in parallel with other heating system improvements. The use of more efficient, lower temperature radiators with conventional fossil fuel heating systems provide consumers with more comfortable homes and lower energy bills. This is because the boiler does not have to work as hard to reach the desired temperature and has a lower modulation level. As homes are becoming increasingly more energy efficient with lower heat losses and therefore reduced heat demand, it is no longer necessary to heat water to the traditional level of 80°C to warm rooms to a comfortable temperature. The point at which water condenses is 55°C which means that in order for a boiler to condense, the water returning to the boiler must be below this level. By lowering the flow temperature, the boiler works at maximum efficiency therefore remains in condensing mode for longer. This has a direct impact on gas consumption and thus household fuel bills.

To ensure that homes are future proofed, we recommend that a low temperature heating standard for new heating systems is introduced. The Domestic Buildings Compliance Guide currently states that 'Systems with condensing boilers should be designed to have low primary return water temperatures, preferably less than 55°C to maximise condensing operation.' The use of 'preferable' means that this standard is not enforceable with many heating systems operating above this point today. To ensure that the heating systems installed are future proofed, we would recommend an alteration to the wording in the Guide to set a maximum

flow temperature of 50°C which will provide benefits to the consumer today by ensuring that the boiler runs more efficiently, reduces energy bills and increases thermal comfort.

To achieve these flow temperatures, it is proposed that when a new boiler is installed the homeowner, in consultation with the installer, could be required to assess the degree to which the heat emitters are future-proofed. This assessment should take into account the potential to incorporate a low temperature heating system in the future, increases to the thermal performance of the property and the availability of controls. The upgrading of heat emitters is essential if we are to enable the transition to more efficient low temperature heating systems irrespective of what replaces the boiler. To support the installation, an upfront grant, reflective of the cost of upgrading the heat emitters, could be provided to consumers replacing their heating system. The replacement of heat emitters earlier, reduces the future cost of switching to renewable, low temperature heating systems. As shown below, in most cases radiators are replaced when a heat pump is installed. Ensuring that homes are future proofed for low temperature heating, reduces the requirement for renewable heating subsidies in the future as some of the ancillary measures will have already been met thus reducing the installation cost significantly.

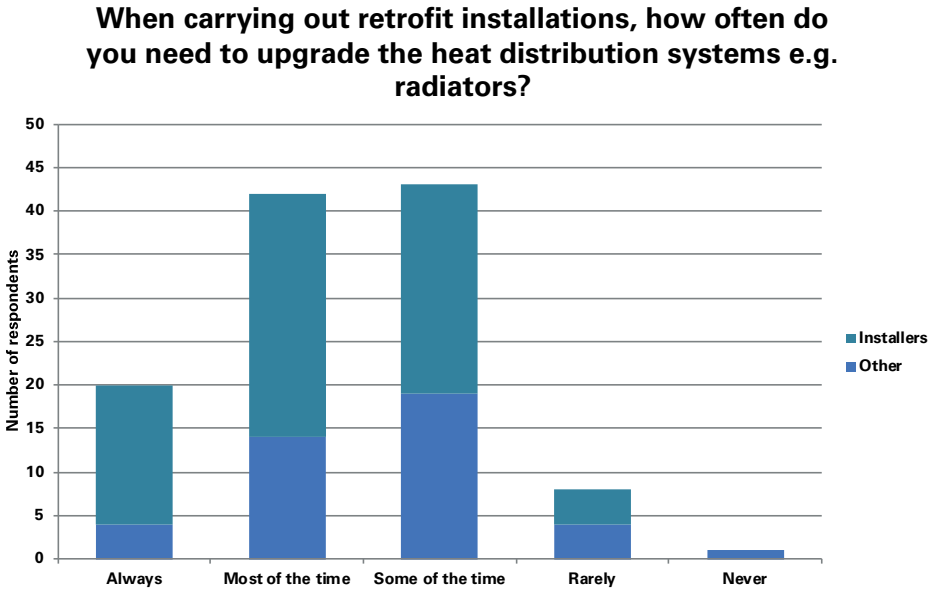


Figure 11 – NIBE installer survey- Question: When carrying out retrofit installations, how often do you need to upgrade the heat distribution systems e.g. radiators?

The need to replace radiators in the majority of cases, could also explain why the majority of installation are made during major refurbishment, when consumers have planned for multiple improvements and are already experiencing some disruption. On average the replacement of heat emitters represents 20% of the installation cost (see Figure 11 below). If it was a requirement to reduce the flow temperatures when new heating system is installed, regardless of fuel type or location, this cost barrier be greatly reduced. Encouraging the replacement of heat emitters would minimise the cost differential between an ASHP and a combi gas boiler to around £2,500. Given the possibility of additional cost down through economies of scale and reduced administrative costs for heat pumps, this cost differential is likely to fall even further.

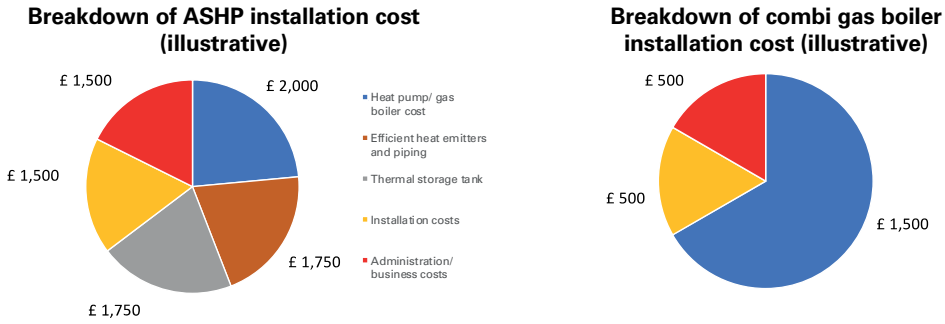


Figure 12 – Heat pump cost breakdown (2015 data)

Renewable heating installers are subject to additional administrative costs compared to fossil fuel heating installers as can be seen in Figure 12. The Government has a role to play in ensuring that there is a level playing field between fossil fuel technologies and low carbon solutions. Without a fair platform on which to operate, the heating market is unlikely to see the step change needed to meet our carbon targets. The Microgeneration Certification Scheme (MCS) which applies to the renewable heating sector is overly bureaucratic and places additional requirements on installers. These requirements add cost to the installation and could be linked to the falling number of renewable heating installers in the UK. Some of the requirements within the MCS should be extended to the fossil fuel heating sector to correct this imbalance and ensure that best practice is followed. For example, MCS requires that heating systems are hydraulically balanced. This is recognised as best practice across the heating sector however there is no obligation on fossil fuel heating installers to hydraulically balance a heating system. This practice ensures that the heating system operates as effectively as possible, increasing consumer comfort and increasing efficiency savings of at least 10%.

Renewable Heat Incentive successor policy

The primary policy supporting the installation of heat pumps in the UK today is the Renewable Heat Incentive (RHI), however it is due to end in 2021 which is when we recommend that the Government should to begin the phase out of high carbon fuels in the off-gas grid sector. As discussed previously, the upfront cost of installing a new, low carbon heating system can be a barrier for many consumers today. The current RHI scheme addresses this somewhat, however the subsidy is provided over a long period of time. Whilst the RHI has proven popular, the timeframe over which the payments are delivered restricts uptake as consumers are still faced with an upfront cost.

For those switching from fossil fuels in off grid homes to low carbon alternatives in a post 2021 scenario without the RHI or alternative financial support, the cost of installation could encourage consumers to try to extend the lifespan of their current system to postpone the investment. This will not only result in increased emissions and lower performance efficiencies, it will also lead to higher fuel bills and could mean that households are left in the cold. Therefore, the introduction of support targeted at the off-grid sector is essential to ensure that households are assisted in the transition. Building a market in this sector will provide economies of scale and encourage a sustainable energy market to develop thus enabling the wider uptake of heat pumps in properties on the gas grid.

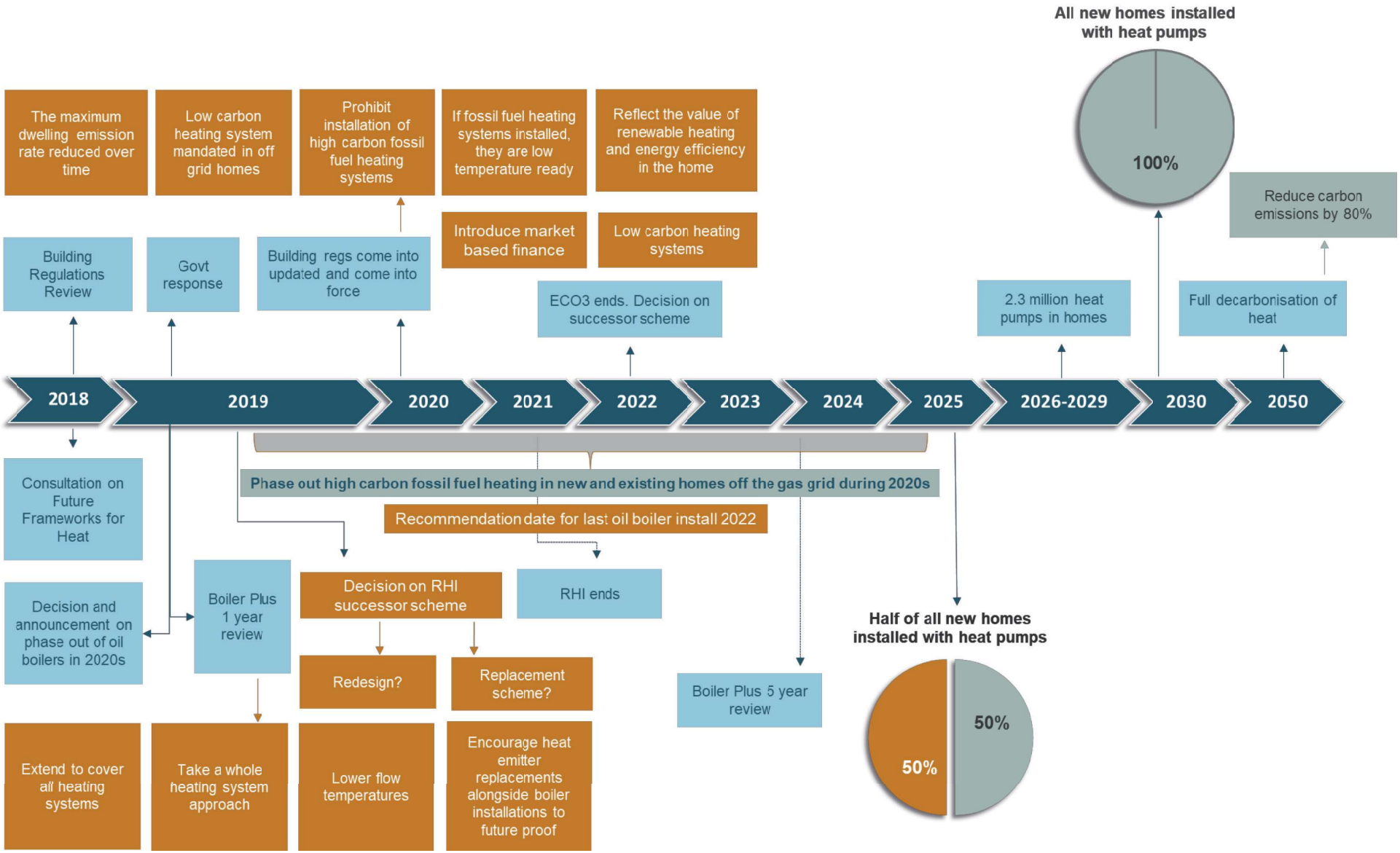
The outright payment for a system relies on sufficient personal savings, access to capital or third-party support. Without these three options, it is unlikely that we will see the required uptake of heat pumps. It is important to note that a range of financial options are needed to enable all household types to access these low carbon, sustainable heating systems. As the market for heat pumps develops, the costs associated with their installation will fall and consumer awareness of the technology will improve.

In the short term, to encourage households to make the mandatory switch from high carbon fossil fuels, a heating system replacement scheme could be introduced. The scheme would only be available for eligible consumers who are switching to a renewable source of heat to reduce the need for incremental changes and future investment. It would provide households with an upfront subsidy towards the purchase of a new system. The scheme could cover the upgrade of heat emitters if required to ensure that the heating system is able to adopt low temperature systems in the future. A similar scheme is in place in Sweden where subsidies are available for the replacement of fossil fuel heating with heat pumps and the replacement system is required to meet a specific minimum performance standard[21].

Strong uptakes in other European countries have largely been driven by subsidy arrangements where the high upfront cost is offset by a capital grant. The UK Government could also opt to extend and redesign the current RHI scheme beyond 2021 to target these homes. In our Vision Report[22], we proposed the redesign of the RHI to include a small upfront payment. The availability of an upfront subsidy has a large impact on the way consumers perceive the investment. It improves consumer confidence as they are not reliant on future payments to offset the upfront cost, for which they may have had to seek alternative finance.

In the longer term, market-based finance and the recognition of low carbon technologies in the price of properties should drive the uptake of renewable heating in 'able to pay' households without the need for government subsidy. Some research suggests that the adoption of renewables leads to a higher sell on price however the value of sustainable energy systems is not quantified explicitly by buyers. Instead buyers seek to purchase homes with good aesthetics, high quality finishes and the appropriate number of rooms. The presence of a renewable energy system or energy efficiency is a bonus rather than a requirement. However, as awareness and knowledge of heat pumps and adoption in the off-grid increase and installation is made easier and cheaper through the future proofing of homes, this may change. Increasing the visibility of the Energy Performance Certificate as part of the buying process could also increase awareness and encourage consumers to purchase more energy efficient, lower carbon properties.

TIMELINE OF RECOMMENDATIONS



References

[1] Climate Change Act 2008 https://www.legislation.gov.uk/ukpga/2008/27/contents

[2] BEIS (2017) Clean Growth Strategy https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651916/BEIS_The_Clean_Growth_online_12.10.17.pdf

[3] Committee on Climate Change (2016) Next Steps for Heat Policy https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf

[4] Committee on Climate Change (2018) Independent Assessment of the Clean Growth Strategy https://www.theccc.org.uk/wp-content/uploads/2018/01/CCC-Independent-Assessment-of-UKs-Clean-Growth-Strategy-2018.pdf

[5] BEIS (2018) Sub national electricity and gas consumption statistics: regional and local authority https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/678653/Sub-national_electricity_and_gas_consumption_summary_report_2016.pdf

[6] National Audit Office (2017) Key facts Housing in England: overview https://www.nao.org.uk/wp-content/uploads/2017/01/Housing-in-England-overview.pdf

[7] BEIS (2017) Heat in Buildings https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651853/Boiler_Plus_final_policy_and_consultation_response.pdf

[8] Committee on Climate Change (2018) Independent Assessment of the Clean Growth Strategy https://www.theccc.org.uk/wp-content/uploads/2018/01/CCC-Independent-Assessment-of-UKs-Clean-Growth-Strategy-2018.pdf

[9] Committee on Climate Change (2015) Sectoral Scenarios for the Fifth Carbon Budget https://www.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-Scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf ¬¬

[10] National Audit Office (2017) Key facts Housing in England: overview https://www.nao.org.uk/wp-content/uploads/2017/01/Housing-in-England-overview.pdf

[11] BEIS (2017) Clean Growth Strategy https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651916/BEIS_The_Clean_Growth_online_12.10.17.pdf

[12] Committee on Climate Change (2015) Sectoral Scenarios for the Fifth Carbon Budget https://www.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-Scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf

[13] BEIS (2018) A Future Framework for Heat in Buildings https://www.gov.uk/government/consultations/a-future-framework-for-heat-in-buildings-call-for-evidence

[14] Committee on Climate Change (2018) Independent Assessment of the Clean Growth Strategy https://www.theccc.org.uk/wp-content/uploads/2018/01/CCC-Independent-Assessment-of-UKs-Clean-Growth-Strategy-2018.pdf

[15] Committee on Climate Change (2015) Sectoral Scenarios for the Fifth Carbon Budget https://www.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-Scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf

[16] BEIS (2018) Energy and Climate Change Public Attitude Tracker – Wave 24 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/678077/BEIS_Public_Attitudes_Tracker_-_Wave_24_Summary_Report.pdf

[17] BEIS (2018) Energy and Climate Change Public Attitude Tracker – Wave 24 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/678077/BEIS_Public_Attitudes_Tracker_-_Wave_24_Summary_Report.pdf

[18] BEIS (2018) Energy and Climate Change Public Attitude Tracker – Wave 24 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/678077/BEIS_Public_Attitudes_Tracker_-_Wave_24_Summary_Report.pdf

[19] https://www.gov.uk/government/statistics/fuel-energy-and-fuel-poverty-in-rural-areas

[20] BEIS (2017) Boiler Plus https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651853/Boiler_Plus_final_policy_and_consultation_response.pdf

[21] Committee on Climate Change (2016) Best practice in heat decarbonisation policy: A review of the international experience of policies to promote the uptake of low-carbon heat supply

[22] NIBE (2017) A vision for the low carbon heating market https://www.nibe.co.uk/news/

news-2017/a-vision-for-the-low-carbon-heating-market/

Data assumptions

Air-source Heat Pump assumptions

Variable	*Value*	*Reference*	*Note*
Price	£3,100	NIBE Energy Systems	Assume a 6kWh unit is installed
Replacement cost (learning rate applied - % of original capex price at year 12)	£2,200	DECC (figure 6.1) Swanson's Law CCC (table 3.3)	DECC report learning rates for different technology groups (9% learning rate for heat pumps in general). Swanson Law used to apply a 9% learning rate every time cumulative number of HPs doubles. CCC gives the estimated number of heat pumps in 2030 (2.5m) and modelling is performed to estimate number of HP's by 2050.
Replacement cost (learning rate applied - % of original capex price at year 20)	£1,800	See above	See above
Lifetime	20 years	National Energy Action	–
Efficiency	360%	NIBE Energy Systems	Likely space heating SPF when heating circuit flow temperature at 35°C

LPG boiler assumptions

Variable	*Value*	*Reference*	*Note*
Price	£2,000	Price Your Job	Modern LPG combi model boiler costs between £1,500 and £2,500 (taken midpoint)
Efficiency	89%	Which	Efficiency of LPG boiler is slightly lower than natural gas boiler (90%)
Lifetime	12 years	ECO 3 Impact Assessment	LPG lifetime same as natural gas boiler
Rental cost/year	£65	Price Your Jpb	
Tank removal cost	£172.5	Flogas	

LPG boiler assumptions

Variable	*Value*	*Reference*	*Note*
Target Fabric Energy Efficiency	54.26 kWh/m^2/ year	NHBC	2013 Part L1A heating requirement for new builds
Average size of a new build home	76m2	Cambridge University	-
Space heating demand	4,124kWh	Calculated →	54.26 x 76 = 4,124
Hot water demand	3,000kWh	NIBE Energy Systems	
Total energy demand	7,124kWh	Calculated →	4,124 + 3,000 = 7,124
ASHP energy consumption	1,979kWh	Calculated →	(1/3.6) *7124 = 1.979
LPG boiler energy consumption	8,004kWh	Calculated →	7124/89% = 8,004

Fuel, emission and discounting data

Variable	*Value*	*Reference*	*Note*
Electricity price	17.92p/kWh	BEIS	Central domestic price in 2018
LPG price	6.56p/kWh	Notts Energy	LPG price in March 2018 – 6.49p/kWh based on 90% boiler efficiency. Adjusted to boiler efficiency of 89% to give to 6.56p/kWh. (6.49*0.9)/0.89

Carbon prices	£67/tCO_2e to £227 tCO_2e	BEIS	Non-traded central carbon prices (G15:G45)
Electricity carbon intensity	0.213kgCO^2/kWh to 0.028kgCO_2/kWh	BEIS	Grid-average consumption-based domestic electricity emission factors (G21:G52)
LPG carbon intensity	0.21451 kgCO_2/kWh	BEIS	Gross CV. Fuels tab (E34)
Discount factor	3.5% (reducing to 3% after 30 years)	HM Treasury	3.5% to 30 years. 3.0% after 30 years. Annex 6, Table 8: Declining Long Term Discount Rate