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Decarbonisation: heat pumps in the home

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A new UK government paper has set ambitious targets for domestic heat-pump installations. What will it take to achieve?

Buildings produce nearly a fifth of the UK's greenhouse gas emissions, with the majority coming from domestic properties. The energy efficiency of people's homes, 85% of which are heated by natural gas, is therefore a major component to achieving government targets of net-zero emissions by 2050.

For the vast majority of domestic properties, investing in a heat pump does not currently stack up. But this needs to change to meet ambitions to decarbonise homes and buildings. The government is clear that electrification of heat and heat pumps will play a leading role. Now there is clearer policy direction, which should act as a call to arms for policy-makers and participants across the value-chain to act together and prepare for change. A combination of new building regulations, subsidy schemes, improved supply chains and customer propositions will be needed to decarbonise our homes. Success will be achieved, not by working in silos, but through collaboration across the industry.

In November 2020, with the publication of its Ten Point Plan for a Green Industrial Revolution, the UK government has signalled a commitment to heat pump technology. In this, it commits to a target of six hundred thousand domestic heat pump installations a year by 2028, representing a 20-fold increase on current rates.

Heat pump installation target set by the Government in its 10-point plan

The target is just shy of estimates, such as those made by the Committee on Climate Change, that we'll need 19 million electric heat pumps by 2050 in order to meet net-zero.

The big question is how this will be achieved. Current subsidies do not give preferential treatment to heat pumps over other low-carbon heating technologies.

The current Renewable Heat Incentive (RHI) currently worth around £7,000 over 7 years in quarterly payments to owners of heat pumps, has yet to translate into a much-needed mass market roll-out of heat pumps (the majority of funding has been used for biomass installations.) A National Audit Office report suggested that by the planned end of the scheme in April of this year, just 22% of expected installations will have been completed. Meanwhile, its replacement from 2022, the Clean Heat Grant (CHG) will provide a blanket £4,000 cash-based subsidy towards all applicable technologies, regardless of their cost. (The CHG proposes to exclude dual hybrid heating systems that use a mix of renewable and fossil fuels.) This, too, is unlikely to bridge the cost gap to conventional heating technologies.

Arithmetic of retro-fitting

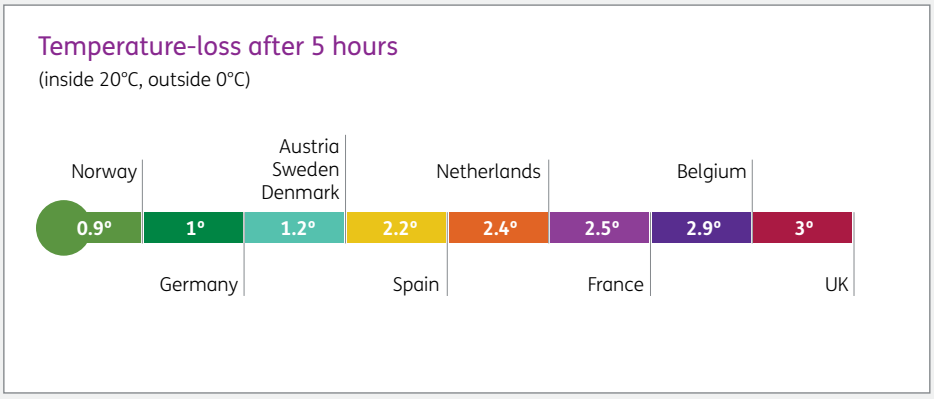
The economics for the end-user boils down to the upfront cost of the heat pump vs. a replacement oil or gas boiler, plus the running costs:

1) Upfront cost

This is currently the main impediment to mass heat pump installations – upfront costs are often significantly more, costing around £8,000 for a 6kW air source heat pump (ASHP), compared with a £1,200 condensing gas boiler[1].

While oil boilers are more costly than gas boilers, at around £4,500, these are typically installed in larger, poorly insulated homes with larger heating requirements, so may need a larger heat pump.

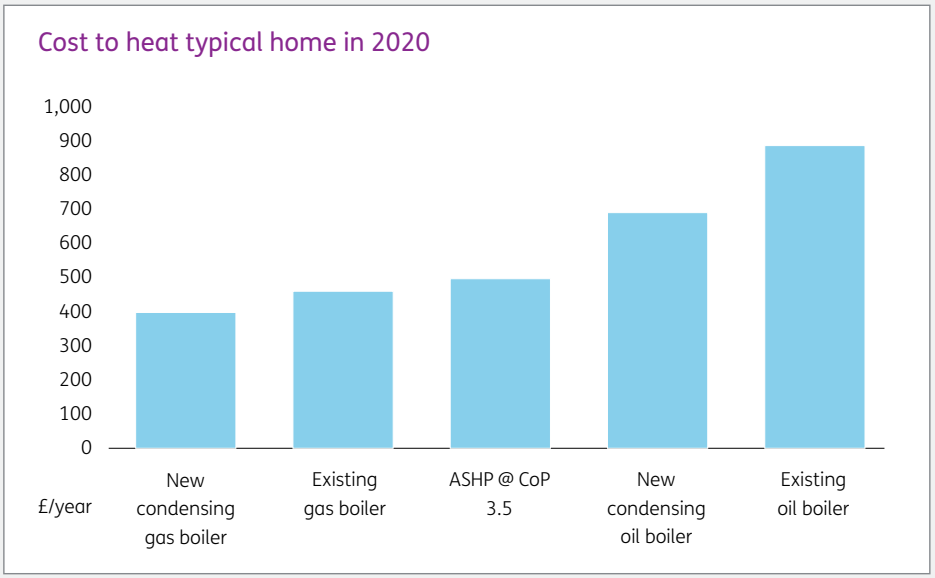
The level of insulation of the property is an important component; well-insulated homes mean heat pumps are able to work at a lower temperature, reducing the overall heating requirements. This also means that heat pumps work better in warmer temperatures. However, the UK has one of the most poorly insulated domestic property stocks in Europe, with an indoor starting temperature of 20°C and an outside temperature of 0°C, UK homes lose on average 3°C after five hours, a rate three times faster than in Germany and Sweden[2]. External wall insulation for a semi-detached 3-bedroom house could add an additional £10,000 to a heat pump installation.



Source: Tado, 2020

2) Running costs

For a typical UK home, with poor insulation and annual heating demand of 11,700 kWh, and accounting for the efficiency of competing technologies and fuel costs, air source heat pumps can just about compete with gas boilers, and are cheaper to run than oil. Despite the far higher fuel-to-heat ratio of heat pumps (200-400% on average) vs. thermal boilers (75-90%), the disparity between retail electricity and gas prices almost completely offsets any running cost savings. The lack of net cash savings means heat pump projects will appear unattractive compared to gas, as there is no opportunity to achieve a payback on the far higher upfront investment.



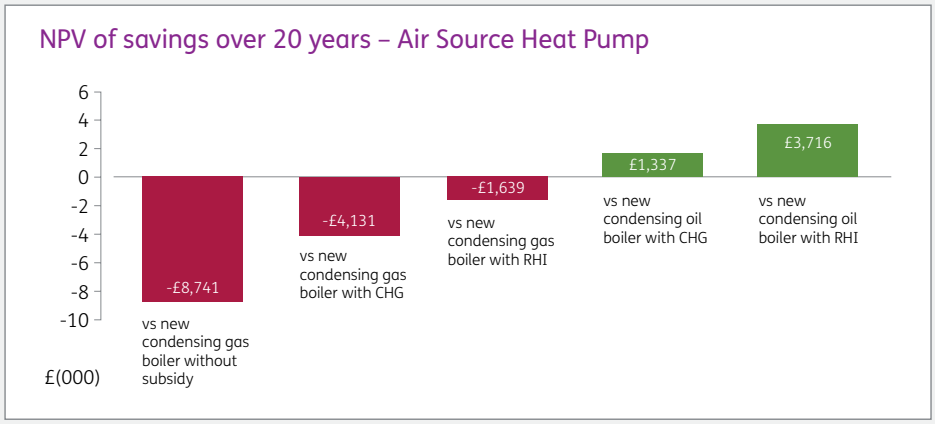
Source: Baringa Partners analysis

[1] Based on a semi-detached 3-bedroom house
[2] Tado, February, 2020

Current subsidy effects

The net present value of savings or losses suggest that heat pump installations that use either the current RHI or the future CHG, will in some instances be more economic than a new oil boiler. (It's worth noting there are still about 1.5m homes in the UK not connected to the main gas grid, and use oil boilers for heating.)

However, even with the current RHI subsidy, our analysis shows heat pumps register a net loss of £1,600 over a 20-year lifetime compared to a new gas boiler, once the avoided cost of a replacement boiler is built in. Moreover, under the new CHG, the loss is even greater, since the gross value of the subsidy is less than the RHI (although some consumers may prefer a cash grant to an ongoing payment.)



Source: Baringa Partners analysis

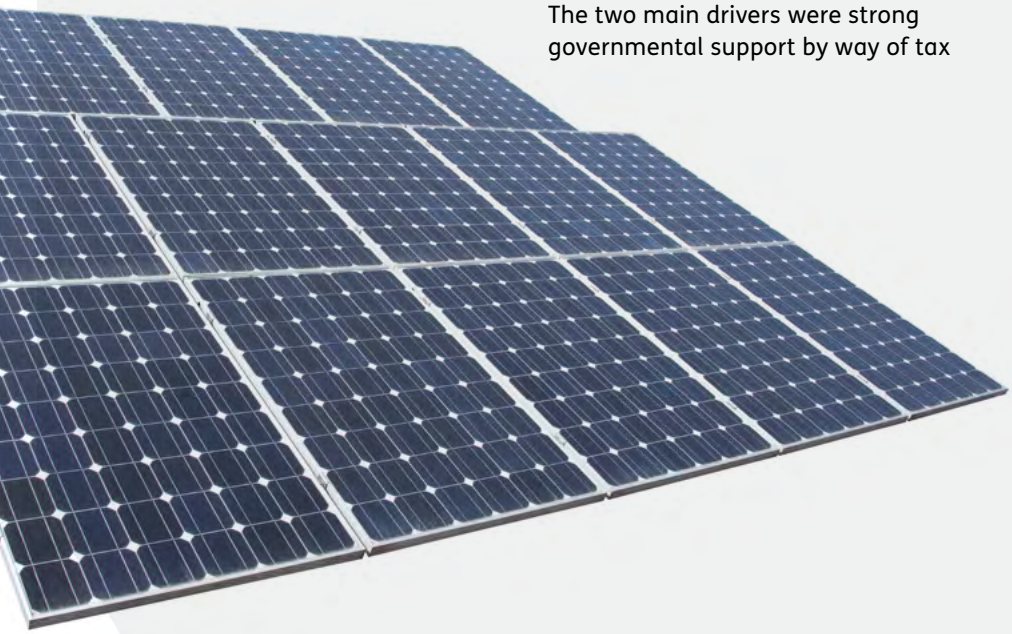
Lessons from other markets

The heat transition could learn from other similar markets, such as EVs and solar

The country with the highest proportion of electric and hybrid vehicles is Norway, where subsidies are so high it almost makes it a 'no-brainer'. There are also high state and federal subsidies for EVs in the US, especially in California, which accounts for around 25% of all US EV sales. Indeed, recent experience from the Netherlands, Denmark and China shows that EV sales begin to decrease quickly once subsidies are removed.

Similar parallels can be drawn with rooftop solar in the US and Europe, where many countries have experienced high growth over the last decade. The two main drivers were strong governmental support by way of tax credits, generous feed-in tariffs and net-metering schemes, which in turn contributed to significant falls in the cost of the technology. However, rooftop solar, especially in areas that are relatively less sunny, is another example of a somewhat new green technology seeing its market significantly reduce once government support is removed.

Even with government subsidies, compelling customer propositions and efficient business models are still required to achieve high growth. Solar markets have benefited with clear propositions that fit seamlessly with supply tariffs, and offer competitive financing to remove the burden of upfront investment.



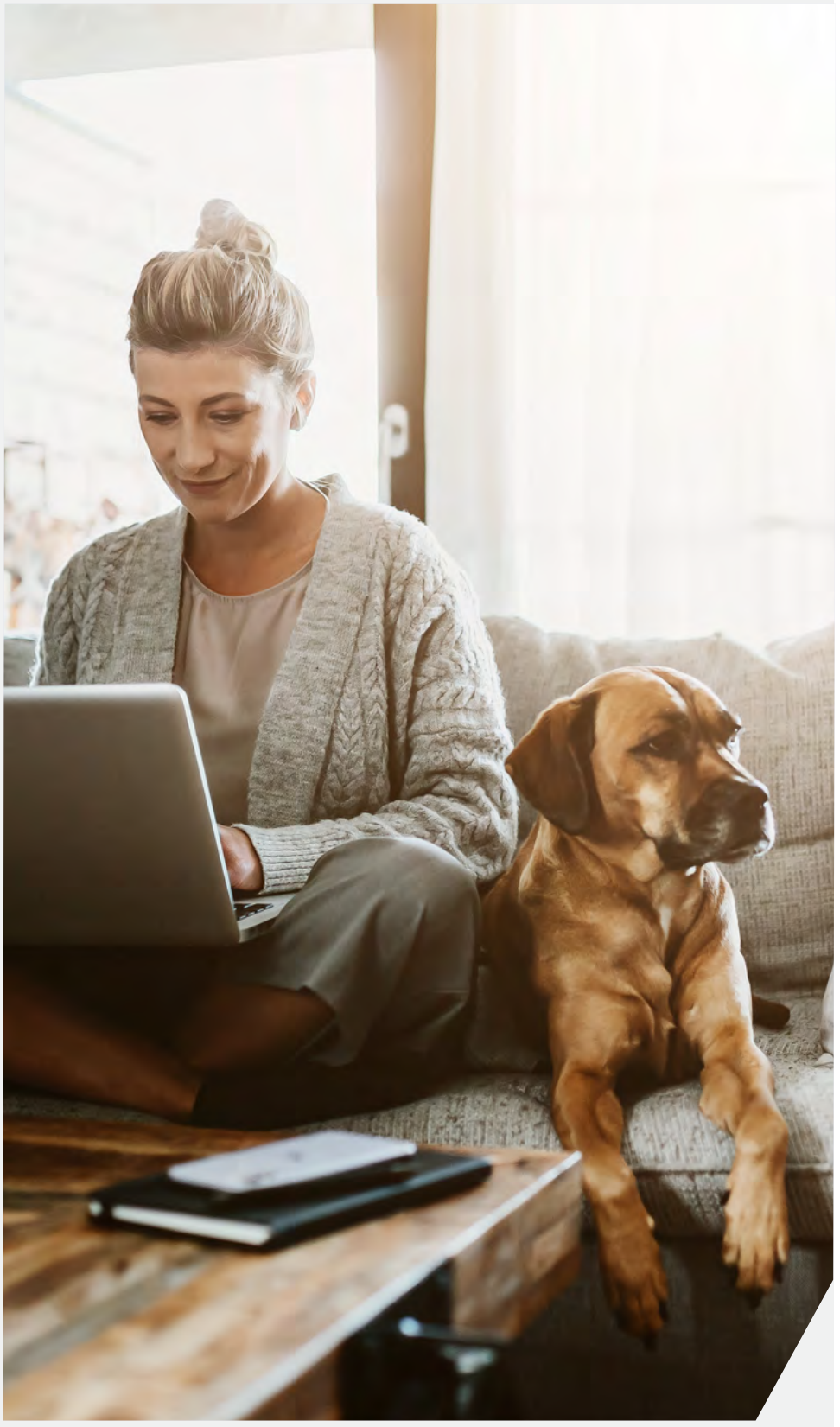
Learning rates

Over time, heat pumps will fall in cost, as adoption that is driven by government intervention will lead to market-led innovations to achieve greater production efficiency. Indeed, boiler installation firms are beginning to pivot to heat pumps to prepare for this growth in demand, which should dampen costs. Learning rates for heat pumps have been cited at between 10-20%, albeit from limited studies and also with high variability between markets.

Assuming a 10% learning rate (cost reduction for every doubling of sales) and Baringa's projection for heat pumps sales, there could be a 34% reduction in Capex by 2030, although this would still be unlikely to result in positive savings vs. gas without further subsidy support.

Similarly, running costs of heat pumps can be improved both by energy efficiency upgrades to properties, as heating requirements are reduced, and through increases in the performance of the technology – an increase of the annual average coefficient of performance from 3 to 4 would result in a 20% decrease in running costs, which could create a level playing field with gas boilers.

These falling production costs will support the medium- to long-term case for heat pumps. In the near-term, the arithmetic of heat pumps poses some real economic trade-offs for policymakers and consumers.

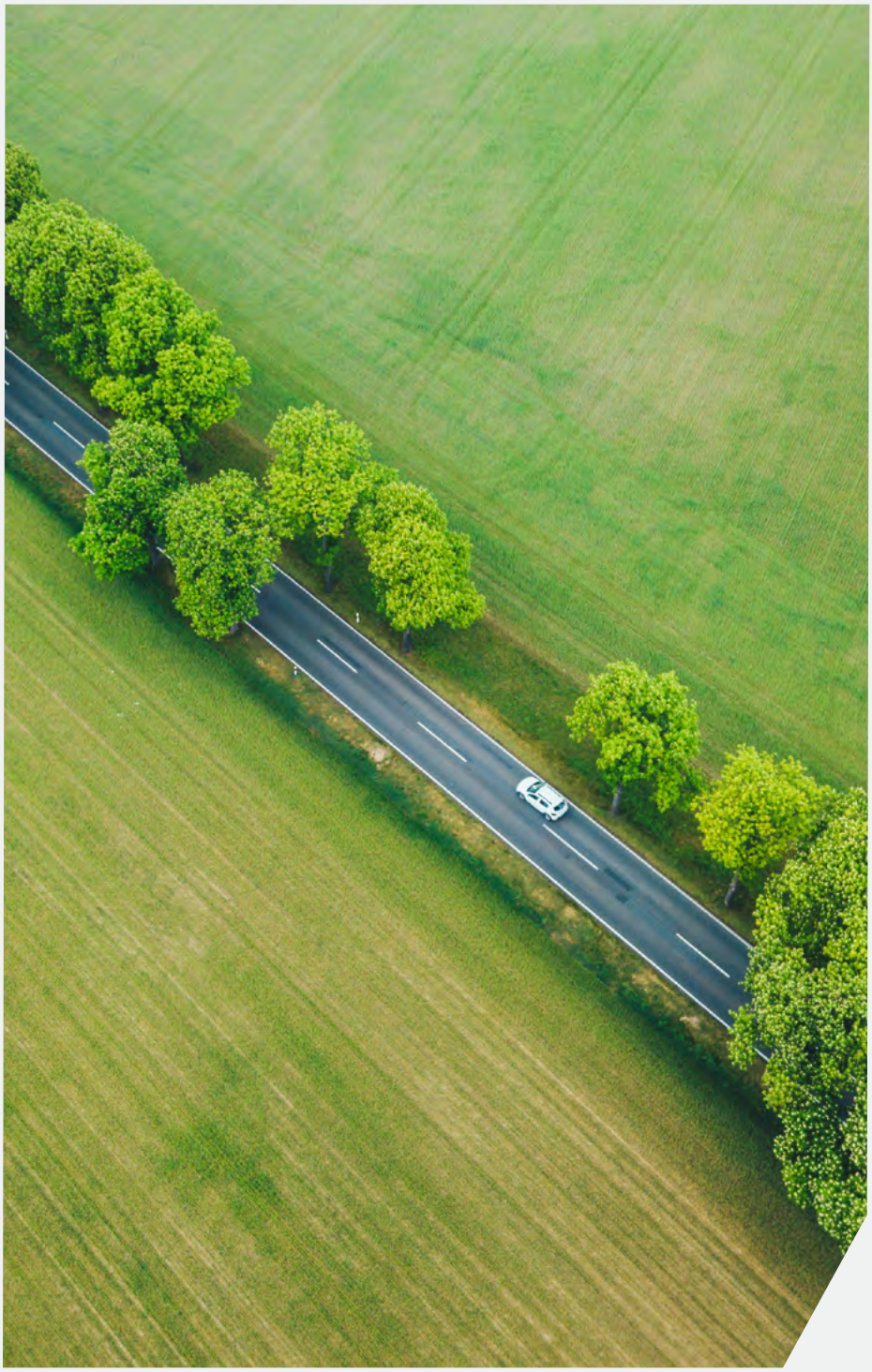


The consumer perspective

To some degree, the adoption of these devices will be driven by the consumer, not buried in the supply chain – as such the consumer must be front and centre of the debate. Heat pumps will be fitted to people's homes, in a process the consumers themselves may have to manage. The installation process is involved, requiring penetration of cavity walls and an expertise that currently does not exist in sufficient quantities.

The heat pumps themselves provide a very different heating control experience to what most UK households are used to – it will not be a flick of a switch, a crank of the thermostat, and radiators pumping out heat. Perhaps the UK consumers will adapt happily to all this, but nobody knows because, for one thing, the majority of the UK population haven't even heard of low-carbon heating technologies, and almost a third of gas-users thought they were on 'environmentally friendly heating'.

There is a widespread misunderstanding of energy efficiency and lower-carbon alternatives to traditional heating that must be addressed before you can even talk about the benefits of heat pumps. Some point to the Tesla-effect in making electric vehicles 'sexy and cool', although it is debatable if cars and boilers are truly comparable economic choices.



Real options

If heat pumps are to become mainstream, investments in consumer awareness, stronger initial subsidy support, and innovative propositions and business models will be needed.

To meet heat pump and net-zero targets, stronger government support, by way of subsidy and regulation, is likely to be unavoidable.

Next, a realistic consumer awareness campaign is urgently required. While the costs of heat pumps may be obvious, there may be hidden costs of not addressing the current situation. For example, a recent study showed that the NHS spends £1.4bn a year treating people who live in poor housing[3]. Joined-up policy communication may tie that to the cost of better insulation.

For a consumer-driven market to be established, we really need to see more innovative and customer friendly propositions. Today there are limited options available that are fully financed and offer the consumer locked-in savings.

In addition, the energy efficiency certification scheme (the EPC) may not be compatible with heat pump ambitions, given that it may be more cost effective and less disruptive to install a gas boiler than a heat pump to improve this rating.

Often, the hardest part of transitioning to a complex ecosystem is getting started. The analysis shows that today it is economically viable to transition the off-gas grid market, and the government's focus on this area is logical.

At the same time, the government could identify the proportion of homes that will not be met by replacing natural gas with other fuels and therefore will require heat pumps, and then calculate the necessary level of support for heat pumps, or tax on gas boilers, to bridge the gap to gas and achieve adoption in the desired time-frame.

At this point, the onus will fall on installers, energy suppliers and financiers to bring compelling propositions to market.

Although, currently, heat pumps will not stack up for the vast majority of domestic properties, eventually they will (because this is what is required to decarbonise, either through market-based interventions or government regulation.) There is now a clearer policy direction, and a growing combination of carrots and sticks will continue to support roll-out. This should be a call to arms for policymakers and participants across the value-chain to act together and prepare for change, as a combination of new building regulations, subsidy schemes, improved supply chains and customer propositions will be needed to decarbonise our homes.

[3]Centre for Ageing Better, Care & Repair England, March 2020

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