THE ECONOMY 2030 INQUIRY

SHAPING A DECADE OF CHANGE

Shrinking footprints

The impacts of the net zero transition on households and consumption

Adam Corlett & Jonathan Marshall

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The Economy 2030 Inquiry

The Economy 2030 Inquiry is a collaboration between the Resolution Foundation and the Centre for Economic Performance at the London School of Economics, funded by the Nuffield Foundation. The Inquiry's subject matter is the nature, scale, and context for the economic change facing the UK during the 2020s. Its goal is not just to describe the change that Covid-19, Brexit, the Net Zero transition and technology will bring, but to help the country and its policy makers better understand and navigate it against a backdrop of low productivity and high inequality. To achieve these aims the Inquiry is leading a two-year national conversation on the future of the UK economy, bridging rigorous research, public involvement and concrete proposals. The work of the Inquiry will be brought together in a final report in 2023 that will set out a renewed economic strategy for the UK to enable the country to successfully navigate the decade ahead, with proposals to drive strong, sustainable and equitable growth, and significant improvements to people's living standards and well-being.

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Executive Summary

The 2020s will be a period of significant economic change for the UK, as the nation continues to adjust to life after Covid-19 and gets accustomed to a new era outside of the European Union. Running alongside these will be a third major driver of economic change – the decarbonisation of the economy: a goal toward which, in theory, the UK is making good progress. In the 30 years since 1990, the nation's territorial CO_2 footprint has virtually halved – maintaining this pace to mid-century should get us to net zero.

The next stage on the journey will look different from the previous decades, when we decarbonised electricity generation and cut carbon from production. These had only limited impacts on day-to-day life, with households shielded from direct investment costs which have instead largely been recouped via levies on energy bills. The 2020s, by contrast, will see decarbonisation more directly affecting what and how much households consume. This will have much more widespread impacts than any changes in employment due to shrinking of high carbon sectors and the growth of, others. Different households will be able to adapt or benefit from these consumption changes in different ways, so consideration will be needed to ensure that lower-income households neither face unaffordable costs or are excluded from the financial benefits of the net zero transition. Additionally, policy makers will need to consider who is picking up the societal costs of remaining carbon-intensive activities, and that interventions to change behaviours do not push up the cost of living for families on lower means.

This report therefore considers how this next stage of the net zero transition will impact on living standards, particularly for households on lower incomes. It examines two key issues:

- the need to catalyse large amounts of upfront public and private investment that will both reduce emissions from home heating and surface transport, but also unlock sizeable savings in future years; and

- behavioural changes in areas where technological change or fuel switching cannot deliver requisite decarbonisation, such as aviation and diets, where the Government is currently hoping for voluntary change, in part due to legitimate concerns about the cost of living for households on lower incomes.

Decarbonising the housing stock is by far the largest challenge in getting to net zero

Homes are the big net zero challenge facing households. Meeting national carbon budgets requires emissions from residential buildings to fall by 44 per cent by 2035, a dramatic increase in pace on the flat-lining seen since 2014. This task breaks down into two components: replacing the gas boilers that heat five-in-six UK homes, predominantly with heat pumps, and insulating the 60 per cent of properties whose energy efficiency rating is below C on the EPC scale before 2035.

Currently, the first of these is receiving more attention. The Government's strategy for widespread clean heat deployment focusses on rapidly driving down the upfront costs facing households by pump-priming the heat pump market. It looks to combine regulations on new homes, a grant scheme for voluntary heat pump upgrades in existing properties, and a 2035 backstop after which no more gas boilers will be installed in UK homes. The hope is that this strategy will deliver rapid cost reductions, so that an installed heat pump will cost the same as an installed gas boiler by the end of this decade. The financial benefits of reaching this goal would be enormous: it would cut £138 billion from the CCC's current forecast of the costs facing households to decarbonise the nation's homes. As strategies go, this makes sense: on CCC projections, heat pump installations in existing

homes do not need to begin at scale until the next decade – 86 per cent of additional household investment is expected in the 2030s and 2040s, rather than the 2020s. So, leveraging private capital and banking on wealthier first-movers to kick start the industry, with time to implement a plan B before the majority of households have to move to clean heat if the hoped-for economies of scale and production efficiencies alone do not deliver enough cost-savings, is a reasonable approach for an equitable clean heat transition.

Reversing a decade of abject policy failure on energy efficiency is the key priority in decarbonising our homes

The focus on heat pumps in the Government's Net Zero Strategy ignores, however, the most immediate challenge: insulating nearly 20 million homes. Just 40 per cent of UK homes currently attain a C rating on the EPC scale – the level the Government has set as a target for all homes to achieve by 2035 – and the remaining 16 million will need further insulation measures. This figure represents an improvement on 2010, but progress has slowed significantly since the early 2010s, and some of the improvements are driven by new homes being considerably more efficient than the average property. Therefore, improving building efficiency should precede widespread heat pump installation: CCC projections envisage that 80 per cent (£45 billion of £55 billion) of the required investments in energy efficiency needs to be made by 2035.

Insulation is important for two reasons: first, improving the energy efficiency of the building stock will enable a smoother uptake of heat pumps, which work more efficiently and cheaply in better-insulated buildings. Second, better insulation can help households make cost savings now through lower energy bills, with the current energy crisis bringing the poor thermal performance of British housing into sharp focus. Inefficient homes have always cost more to heat but, after prices jump this April, a family with typical energy consumption living in an EPC E rated home (4.2 million British households) are set to face a bill £320 higher than if they lived in an EPC C rated property. When domestic energy prices rise in April, the 16 million British homes currently rated EPC D or below will see occupants pay a cumulative £3.9 billion a year more for heating than they would if they all met the EPC C standard.

This 'efficiency gap' is the result of a decade of policy failure that has not tackled long-established issues with the UK antiquated housing stock. This began in 2013 with decisions to reduce public funding for energy efficiency schemes, and to switch from a regulatory to a demand-led strategy, and has been compounded by policy failures since. The 2019 Conservative manifesto pledged more than £9 billion for building upgrades over a ten-year period, but crucially, the majority of spending outlined in the Heat and Buildings Strategy and Spending Review is for social housing and public buildings, leaving home owners largely unsupported. Efficiency installations in Britain's homes fell by more than 90 percent from upwards of 2 million per year in 2012 to less than 200,000 within a year, a level at which they remain to this day. The longer this status quo persists, the longer households will face higher energy bills than they need to.

Regulation could drive rapid progress in the private rental sector, but poorer owner occupiers risk being left out in the cold

The UK's heterogeneous housing stock means there is no 'one size fits all' solution. Discrepancies in energy efficiency are predominantly driven by property age and type, with older and detached homes less efficient, on average, than flats and new homes. This leads to a wide distribution of thermal performance for homes in different parts of the country – for example, nine-in-ten households in the Scilly Isles will need their homes insulating before 2035, compared to just one-in-four in Tower Hamlets. The Government's current plan is that social landlords will be responsible for (and funded to) improve efficiency in their properties, so the main direct impact on households from the need to improve energy efficiency will come from owner-occupied and privately-rented properties, where just under six-in-ten (58 per cent in both tenures) will need upgrading.

For the private rental sector, imminent new regulations would see all privately-rented properties in England and Wales be required to attain an EPC C rating by 2028. If enacted and enforced, this would see 2.8 million homes upgraded in just a few years, leading to better-insulated homes and lower bills for close to 8 million people. This would represent a dramatic increase in pace on historical progress in the private rental sector (PRS), in which the share of

homes rated EPC C or higher would increase by more than 40 percentage points inside six years, compared to by growth of just 7 percentage points over the past five.

Given that both landlords and tenants currently lack incentives to improve the energy efficiency of rental properties, this policy approach is appropriate, and has the potential to bring rapid improvements in housing standards and lower energy bills for many millions of people. There are risks, though, including that the target is not adequately enforced or policed, or that the industry is not able to ramp up capacity, particularly if landlords leave changes until the last possible minute.

But for all these risks, at least there is a plan for the PRS – the same cannot be said for helping poorer homeowners with the cost of upgrades. 72 per cent of the poorest homeowners live in properties that will need improving, a figure that reaches as high as 81 per cent in London, and is greater among younger (under 30) and older (pension-age) cohorts. Owner-occupier households in the bottom fifth of the income distribution have an average after housing costs income of around £9,100 a year and face an average upgrade costs of around £8,600, so some policy response, such as delivering the funding for low-income households that was pledged in the 2019 Conservative manifesto, will clearly be needed.

Surface transport is the largest source of emissions, but there are signs that rapid change is underway

The 2020s will see rapid change in how the vast majority of households travel. Replacing the 32 million cars on UK roads with electric alternatives will be an immediate and obvious aspect of the net zero transition, with CO_2 from surface transport – currently the largest contributor to UK emissions – required to fall by 73 per cent by 2035. In good news, initial fears that the vehicle stock would not turnover with sufficient pace appear to be misplaced, with electric car (EV) sales outpacing the most ambitious CCC estimate by two years, and now accounting for one-in-five new car purchases. This is driven by falling prices, thanks to product innovation and growing economies of scale. Although EV sales (along with car sales in general) are concentrated among wealthier households, the growing prevalence of leasing deals to purchase new cars mean it will be only a few years until more affordable

electric cars appear en masse in the second-hand market, allowing lower-income households access to cheaper and cleaner motoring.

Fair pricing and access to the public charging infrastructure is the key focus for this decade

Although up-take of EVs may not be a concern, a key living standards issue is how savings from EV use will be shared across all households. At present, different families will be able to save very different amounts depending on their access to charging infrastructure, with the over-arching factor whether cars can be charged at home – where savings will be larger – or using the public charging network.

In particular, while households with off-street parking and using low-cost overnight tariffs could see annual fuel costs of just £139 (or £389 via daytime charging), drivers with no choice but to use the public network – and 9.8 million households across England and Wales currently don't have access to a garage or off-street parking – currently face typical costs of £712 per year. This is a result of unregulated pricing and differential tax treatment, and will require government intervention. Additionally, some home chargers will shortly be able to participate in vehicle-to-grid services which could cut annual fuel costs to near zero (just £39 per year).

Drivers using public chargers will still save money compared to using a petrol or diesel engine – with the comparable cost being around £1,100 – but the ability to access the greater savings from at-home charging is currently not distributed equally. Wealthier households are more likely to have access to off-street parking, but there are also clear disparities by housing tenure – just 51 per cent of private renters have access to off-street parking at home, compared with 81 per cent of owner occupiers. Further complications face the UK's 4.6 million leaseholders, where legal issues could prevent them from installing or accessing charging at home. As electric vehicles become more widespread, it is this differential ability to reap the savings from cleaner transport that will likely become the main cost of living issue.

Additionally, the size of the public charging network needs to ramp up dramatically to meet future demand: CCC projections require a ten-fold increase on the number of chargers installed by 2030, when total numbers will top 280,000. This should, in theory, be delivered by the private sector responding to growing demand, but policy makers will want to keep a keen eye on how evenly this infrastructure is distributed around the country. For example, in Westminster there are 44 registered cars (of any type) for each public charger, whereas in Castle Point in Essex, there are 16,400 cars for each charger. If this isn't corrected, there is a risk that, at least until both EVs and chargers become ubiquitous, some areas could remain as blackspots, leaving shorter-term take-up of EVs skewed to wealthy areas.

Reducing meat and dairy consumption is an important part of shrinking our footprints, but encouraging alternatives should be a higher priority than raising prices

Even more so than flying, changing our diets to reduce their associated greenhouse gas emissions would mean a noticeable change in day-to-day behaviour, and could affect a larger share of household spending. The CCC suggest that a 20 per cent fall in meat and dairy consumption is needed by 2030, and a 35 per cent fall (or more) for meat by 2050. This would directly reduce emissions (in the UK and overseas), but also help free up an area larger than the North of England for reforestation and other uses. But how that happens is important for household finances, as well as public opinion. At the aggressive end of the scale, emissions trading could be rapidly extended to agriculture and food imports (currently there is no carbon pricing in this sector), or standard VAT extended to some food products, for example. But any rise in the price of food would be relatively regressive – at least before considering any behavioural change or redistribution – with the bottom half of the income distribution accounting for 43 per cent of meat and dairy spending and the top tenth 12 per cent (in stark contrast to aviation spending). There are also a range of significant disruptions facing UK agriculture already, including a changing trade landscape, and the practicalities of agricultural emissions pricing are still to be worked out (discussions are ongoing in New Zealand, for example).

The Government has also been reluctant to take an active stance – even retracting a research paper that discussed the topic. This all suggests that we should not expect major policy interventions any time soon, particularly given the current cost of living crisis. However, there are also tentative signs that the required dietary change and innovation is happening. Average meat consumption fell by 17 per cent over the ten years to 2018-19, and a 20 per cent consumption reduction by 2030 would be in line with longstanding trends for many (though not all) forms of meat and dairy. This is welcome news, as the ideal would of course be for (enough) consumers to voluntarily shift towards lower-impact, healthier, and potentially cheaper diets. This is not to say that the Government should do nothing in this decade – it can at least play its part through public procurement, labelling and reporting, encouraging innovation and competition, and public subsidy reform, for example. But an undesirable outcome would be to raise prices and for consumers not to respond, so the emphasis for now must be on increasing the desirability and normality of lower-impact food options.

Technological change and investment are not the only changes needed in the medium-term, and behavioural change will need to include constraining aviation growth

In the cases of heating and driving, the route to decarbonisation is a technological one. But technological solutions are not going to be able to eliminate greenhouse gas emissions in every sector by 2050, and so a second major challenge is to limit demand for those goods and services that still contribute to global warming by changing patterns of consumption. Most notably, that includes flying and food, which will account for the majority of households' gross greenhouse gas footprints by 2050.

Although flying has historically become more common over time (with the significant exception of the pandemic), the CCC's path to net zero requires passenger numbers to remain flat between 2019 and 2035, although the sector could grow beyond then – with 17 per cent growth in per-person air travel between 2019 and 2050 overall. The Government has been reluctant to take steps to reduce demand (for example, by restricting airport expansion or raising taxes); indeed, taxes on domestic flights have recently

been reduced (though flights within the UK and EEA are covered by emissions pricing). As a result, the CCC has noted that the Government's Net Zero Strategy has 'nothing to say' on this topic, which might suggest that new policy changes will be needed in future.

Any such change would likely involve increases in the price of flying. But expenditure on flying is very unequal, with a greater relationship to a person's total spending than any other major consumption category. Pre-pandemic, the top 10 per cent of the income distribution were spending more on flying each year than the bottom 50 per cent combined, accounting for 28 and 24 per cent of aviation spending respectively (this does not include business trips, which make up 17 per cent of international flights and 38 per cent of domestic flights). Aviation is also a smaller component of household spending than heating, surface transport or food, for example, and for most people it is not a comparable essential. Existing or potential future policies aimed at curbing demand for flying should therefore not cause us to worry too greatly about impacts on household living standards, at least compared to most other sectors. Indeed, it is important that the aviation sector does not underperform in terms of emissions reductions, something that would shift the burden of decarbonisation even further onto other sectors, and involve asking non-flyers to incur higher costs elsewhere.

Managing how the costs and savings to households from net zero are distributed is a key challenge in the 2020s

It is clear that day-to-day life in the 2020s will be far more affected by the path to net zero than in the past, and the consumption aspect of net zero could be a significant determinant of living standards. Issues associated with investing now to save later will be imperative for transport and home heating. Policy makers will need to ensure that investment in building insulation and the public charging network allow the switch to clean transport and heat to be made in way that shares cost savings widely, and does not overburden low-income households with up-front costs. On the Government's current strategy, the areas of flying and food are likely to present less of a challenge to household budgets, but they may well yet require policy change to ensure that these

sectors do their bit and don't push additional costs on others. How best the Government should do this, alongside responding to the challenges of being outside the EU and the aftermath of Covid-19, will be the subject of future Economy 2030 reports.

Section 1

Introduction

The 2020s are set to be a decade of significant change for the UK. Living standards are already coming under pressure from high energy bills, rising inflation and falling real wages. Add changes to the economy associated with recovering from Covid-19, from a new direction on policy and regulation outside of the EU, and from continuing to make progress to net zero emissions and it is clear that this decade will not be like those that have come before.

At first glance, the UK is making good progress towards net zero: national territorial carbon emissions have virtually halved since 1990, and maintaining this pace would see the nation end its contribution to climate change by mid-century. But the vast majority of decarbonisation seen in the UK over the past 30 years has occurred in the background, via greening generation of electricity and reducing emissions from the production of goods and services. As such, effects on day-to-day life have been minimal – where electricity is generated does not affect the user experience of charging a mobile phone – and the direct costs have been largely hidden from households, borne instead through levies on electricity bills.

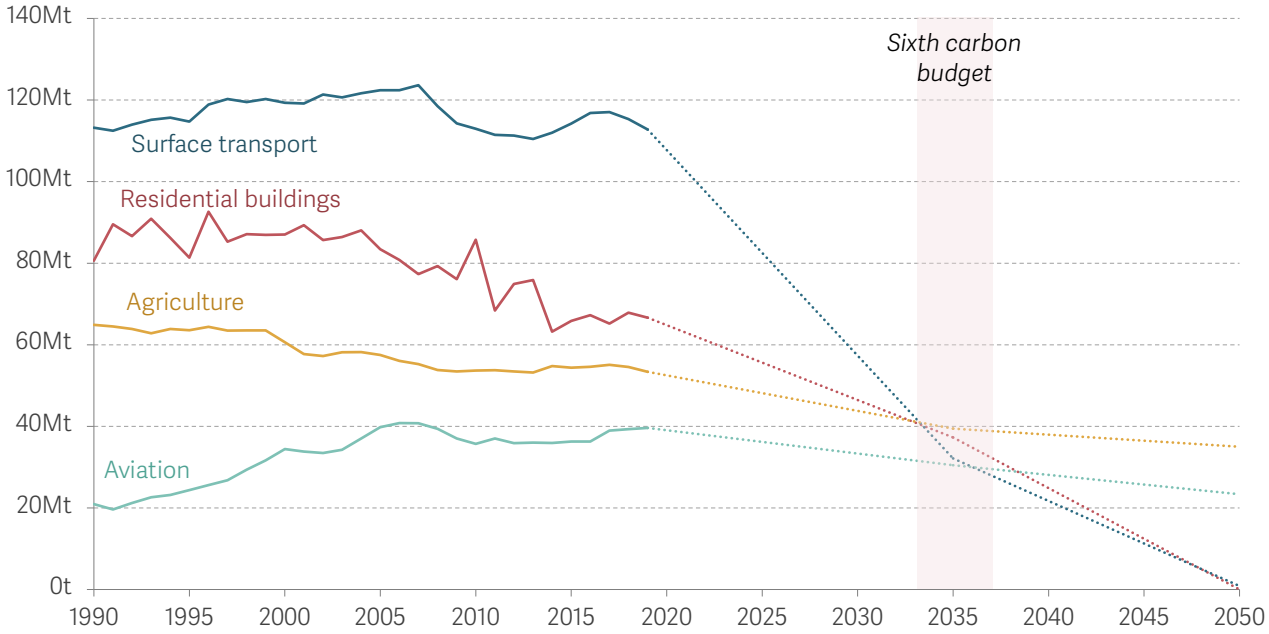
As we have argued before, though, this approach to climate policy will have to change as we move through the 2020s.[1] As Figure 1 shows, household emissions from driving (surface transport) and staying warm at home (residential buildings) will need to fall dramatically during the 2020s if the UK is to meet its legally binding Sixth Carbon Budget (covering 2033-37). This will require reductions of 44 per cent and 72 per cent on 2020 levels, respectively, according to CCC projections. Household emissions from food and flying will need to fall more slowly, both down around a quarter (26 per cent and 23 per cent) over the same time period. Together, these four sectors account for more than half (52 per cent) of total UK emissions, and dominate the 'personal' emissions of households. Reducing these emissions, which are associated

1 See: J Marshall & A Valero, The Carbon Crunch: Turning targets into delivery, Resolution Foundation, September 2021

with households' consumption of goods and services will have a clear and immediate impact on living standards, impacting virtually every family in the country, and stands to be much more significant a change to lives than the changes to jobs, for example.[2]

FIGURE 1: **Decarbonisation of household-facing sectors needs to accelerate if the UK is to meet its net zero targets**

Historical greenhouse gas emissions from selected sectors and reductions needed to meet the sixth carbon budget and 2050 net zero target, $MtCO_2e$: UK



SOURCE: Analysis of Climate Change Committee, Department for Business, Energy and Industrial Strategy data

There are two parts to the consumption challenge of net zero:

- Making upfront public and private investment to unlock cost (and carbon) savings later. Here, the overarching policy challenge is to manage the mismatch between upfront capital investment and (longer-term) reduced operating costs. On aggregate, the CCC's Balanced Pathway includes £27 billion a year of additional annual public and private investment in the 2020s, falling to £16 billion per year in the 2030s, before an average annual net payback of £11 billion from 2041-50.[3] This payback is a result of lower operating costs that will particularly benefit households as consumers: out to 2050, surface transport is the largest source of operational

2 Combined greenhouse gas emissions from these four sectors totalled 272 million tonnes of CO2e in 2019. BEIS reported values for agricultural emissions are taken as a proxy for food. See: Final UK greenhouse gas emissions statistics. This focus on consumption is not to discount embedded emissions from manufacturing, services and construction, but much of these will be reduced by further decarbonising electricity generation – the Government has an ambition to decarbonise the power grid entirely by 2035 – by vehicle decarbonisation, and by reducing emissions from non-domestic heat.

3 The implications of this for public investment are discussed in: K Shah, J Smith and D Tomlinson, Under Pressure, Resolution Foundation, February 2022, as well as: Fiscal Risks Report, OBR, July 2021.

savings (42 per cent of the total), with significant contributions from residential buildings (9 per cent) and electricity generation (12 per cent).[4]

- Changing behaviour to reduce activities that emit greenhouse gases that cannot be solved by technological development.

The first of these will predominantly affect home heating and surface transport, whereby investment is both needed in specific consumer goods (i.e. heat pumps and electric cars, respectively) but also in complementary assets such as building insulation and the charging network needed to deliver lower running costs. Here, policy makers will need to consider how to curate the upfront investment in a way that does not see the costs of climate action land upon households who are least able to bear it, while also ensuring that lower-income families are not excluded from banking their fair share of savings. The second issue is more important for flying and food, as the technology for emissions-free farming and aviation is yet to materialise. Here, the policy challenge is that slower-than-expected behaviour change will necessitate additional decarbonisation in other sectors, bringing a distributional risk if the emissions are a result of activities by wealthier households.

The Government's approach to decarbonising these sectors was set out last autumn in its Net Zero Review (see Box 1), and we comment more on this later in this report.

BOX 1: **The Government's approach**

During 2021 the Government released a large number of sectoral decarbonisation plans, culminating in the Net Zero Strategy which, delivered in the run up to COP26, outlined a route to reaching the Sixth Carbon Budget.[5] The Strategy fleshed out targets initially set out as part of the Prime Minister's '10-point plan for a green industrial revolution', as well as clarifying that a market-based approach based on consumer choices and effective pricing of carbon emissions would be taken.

Key targets included:

- Fully decarbonising the power system by 2035, increasing offshore wind capacity to 40 gigawatts (GW) by 2030 and deploying new nuclear generation capacity.

4 Net zero will also bring significant non-financial benefits for households such as financial savings from the lower running costs of low carbon technologies, as well non-financial benefits such as cleaner air (see Box 2), less noise pollution and warmer homes.
5 See: Net Zero Strategy: Build Back Greener, Department for Business, Industry and Industrial Strategy, October 2021.

- Realising 5 GW of hydrogen production capacity by 2030.
- Delivering 4 carbon capture and storage (CCS) projects, capturing 20-30 MtCO2 per year by 2030.
- Aiming for no new gas boilers to be installed in homes after 2035, offering £5,000 grants for heat pumps and rebalancing social and environmental policy costs from electricity to gas bills over a decade.
- Insulating the homes of low-income families and public buildings.
- Accelerating the rollout of electric car chargers and delivering on the 2030 commitment to end the sale of new petrol and diesel cars

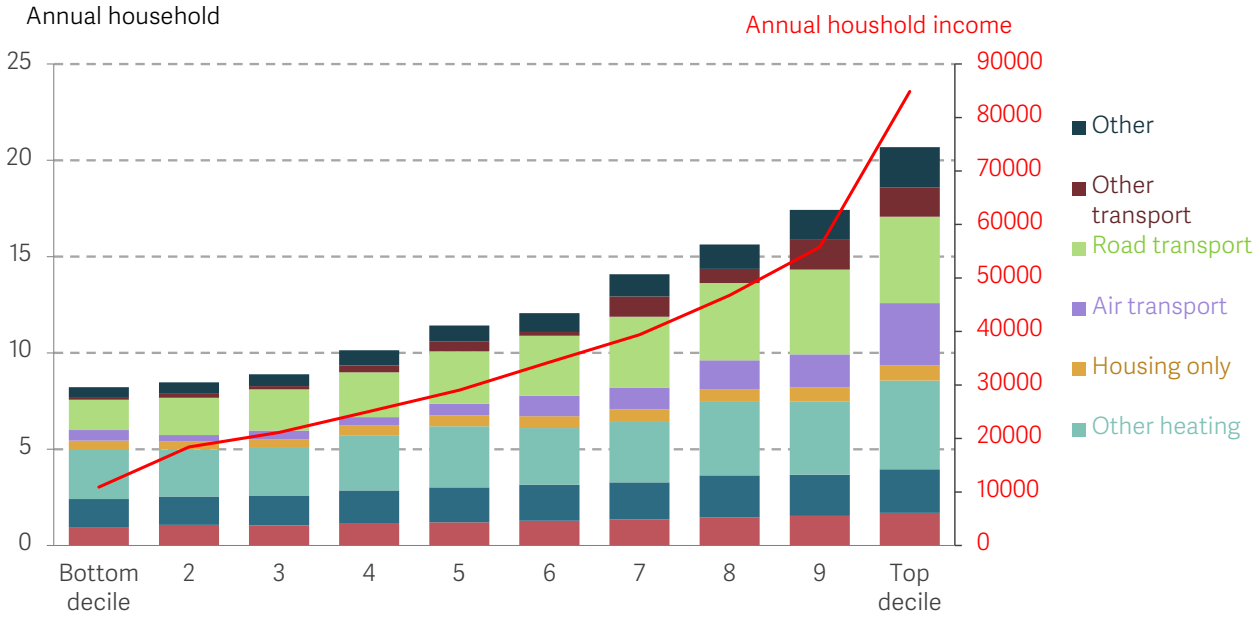
Ambition in the Net Zero strategy is comparable to the Balanced Pathway to net zero, as outlined by the CCC.[6] It includes aims and targets in line with the UK's Sixth Carbon Budget and provides a good base upon which to develop and deliver the policies needed to achieve these reductions in emissions.

When considering our discussion of the four sectors, it is essential to acknowledge how carbon footprints vary with income. Richer households have higher carbon lifestyles, with the highest-income families producing more than double the amount of greenhouse gases per year than those in the bottom half of the income spectrum (Figure 2). Across the sources of emissions that will form the basis of this report, this gap is 2.5 times, a difference driven by increased use of both air and surface transport[7] Forecasts of future household emissions suggest that these income disparities could persist, with richer families continuing to live higher carbon lifestyles.[8] As a result, the mid-21st-century carbon footprints of the bottom half of the income distribution will be driven by food, while the upper half will have a larger contribution from aviation. Ensuring that the costs of actions of richer households are not borne by those with lesser means is imperative for an equitable net zero transition.

6 See: Independent Assessment: The UK's Net Zero Strategy, Climate Change Committee, October 2021.
7 Per household greenhouse gas emissions for food, heating, air transport and surface transport are 14 t CO_2e per year for the highest income decile compared with 5.6 t CO_2e per year for the lowest.
8 See: A Owen, J Burke & E Serin, Distributional impacts analysis of engineered Greenhouse Gas Removal technologies in the UK, University of Leeds and Grantham Research Institute on Climate Change and the Environment, July 2021.

FIGURE 2: **Richer households have the biggest carbon footprints**

Average weekly greenhouse gas footprint by equivalised income decile, 2019, UK



SOURCE: HM Treasury Net Zero Review.

The remainder of this report is structured as follows:

- Section 2 examines the challenges households face in the transition to low carbon heating, looking at both changes to heating systems and to improvements in building fabric needed to both cut energy waste and lower energy bills.
- Section 3 looks at the transition in surface transport, assessing how lower-income households will fare in both changes in car ownership, as petrol and diesel cars are replaced by electric alternatives, and showing the importance of fairly priced and accessible charging for households reliant on the public network.
- Section 4 discusses the gradual changes in behaviour needed to reduce emissions from food and flying, assessing what changes in consumption are already taking place, and whether price signals are a suitable tool to shift household habits.

The challenges and opportunities that face different households identified in this report will underpin further work as part of the Resolution Foundation's Economy 2030 Inquiry. This programme of work will join up the impacts on living standards associated with net zero with those resulting other key drivers of economic change, assessing what that means for living standards and how the UK's overall economic strategy should react.

Section 2

Decarbonising residential buildings and bringing energy bills down

Decarbonising the nation's homes will be one of the most noticeable net zero trends of the 2020s, with carbon emissions created by households staying warm at home needing to fall by more than 40 per cent by 2035. Achieving this target – which ultimately requires replacing 23 million gas boilers and insulating the six in ten homes that fall below the Government's 2035 efficiency target – will mean significant investment and risks causing disruption to tens of millions of households.

The Government's approach to clean heat aims to protect households from large investment costs by rapidly driving down heat pump costs during the 2020s. A combination of regulations on new build homes and grant schemes for homeowners underpin a goal of an installed heat pump reaching price parity with an installed gas boiler by the end of this decade. Given that CCC projections are that 86 per cent of household investment in low carbon heat will come in the 2030s and beyond, this strategy is sensible, as there is still time to introduce further measures should this anticipated cost reduction not materialise.

Instead, the priority for the 2020s is catching up on insulating the nation's homes. Just 40 per cent of UK homes currently attain a C rating on the EPC scale – the level the Government has set as an aspiration for all homes to achieve by 2035 – and the remaining 16 million will need further insulation measures. Improving building efficiency needs to happen soon: CCC projections envisage that 80 per cent (£45 billion of £55 billion) of required investment in energy efficiency needs to be made by 2035, well before widespread spending on heat pumps begins.

This is a task made harder and more urgent by a decade of policy failure – annual efficiency installations in Britain's homes are 90 per cent lower than levels seen in the early 2010s – and by the absence of a strategy to bring forward investment or to

rebuild the workforce needed to deliver a major infrastructure upgrade. Indeed, much of the overall progress on efficiency since then has been driven by the construction of new homes, which are considerably better insulated than the average property. Less-efficient homes have always cost inhabitants more to heat, but surging gas prices make this 'efficiency gap' more pronounced, with a family in a typical EPC E rated home set to spend an additional £320 per year on energy bills than one in an equivalent EPC C rated property when prices rise in April. Across all 16 million British homes that are currently rated D or below, this additional spending will reach £3.9 billion per year.

For the private rental sector, new regulations would see all privately-rented properties in England and Wales be required to attain an EPC C rating by 2028. If enacted and enforced, this would see 2.8 million homes upgraded in just a few years, reducing bills for 8 million inhabitants. There is much less of a plan for helping poorer homeowners. 72 per cent of the poorest homeowners live in properties that will need improving, a figure that reaches as high as 81 per cent in London, and is greater among younger (under 30) and older (pension-age) cohorts. Owner-occupier households in the bottom fifth of the income distribution have an average after housing costs income of around £9,100 a year and face potential upgrade costs of around £8,600.

It is becoming increasingly clear that decarbonisation of the UK's housing stock will be the biggest challenge that households face on the road to net zero, both in terms of scale and in terms of distributional risks. Meeting the Sixth Carbon Budget requires emissions from residential buildings to fall by 44 per cent by 2035, representing a near-quadrupling of the pace seen from 2005-2020.[9]

Accelerating the decarbonisation of residential buildings will see households face two related, but clearly different, changes: insulating leaky homes and replacing carbon-intensive heating systems –gas and oil boilers – with clean alternatives. Both of these are necessary to achieve the 'near-complete elimination of greenhouse gas emissions from UK buildings' that getting to net zero requires.[10]

The Government is currently placing more attention on the clean heat half of this puzzle, embarking on a strategy to shield households from investment costs as much as possible by delivering dramatic cost reductions before rollout begins in earnest. The 2021 Heat and Buildings Strategy outlined ambitions to install 600,000 heat pumps per year by 2028, offer voluntary £5,000 grants to home-owners keen to invest in clean heating systems, implement regulations on homebuilders and bring in a sales mandate on boiler manufacturers. Combined, these policies will work towards the Government's aim of

9 See: J Marshall A Valero, Carbon Crunch: Turning Targets Into Delivery, Resolution Foundation, September 2021.
10 See: UK Housing: Fit for the future?, Climate Change Committee, February 2019.

halving heat pump costs by 2025 before reaching parity with gas boilers (c.£2,000) by 2030.[11]

This focus on heat pumps is understandable. Gas boilers have been a mainstay of British homes for decades and still heat six-in-seven properties,[12] replacing them with a new technology that is unfamiliar to most will involve additional costs, disruption and potential changes in behaviour.[13] But the UK's old and heterogeneous housing stock, while often aesthetically pleasing, is one that wastes significant energy, via warm air escaping through draughty doors and windows, or through poorly insulated walls and roofs. Without addressing poor thermal efficiency, buildings will continue to consume more energy than they need to, locking households in to higher energy bills and meaning that homes will be less suitable for heat pumps, which operate most efficiently at lower flow temperatures. So, it is concerning that the Strategy brought forward no new targets for insulating buildings and failed to deliver all of the funding pledged for energy efficiency in the 2019 Conservative manifesto.[14]

The UK's clean heat strategy centres on priming the market to deliver cost reductions

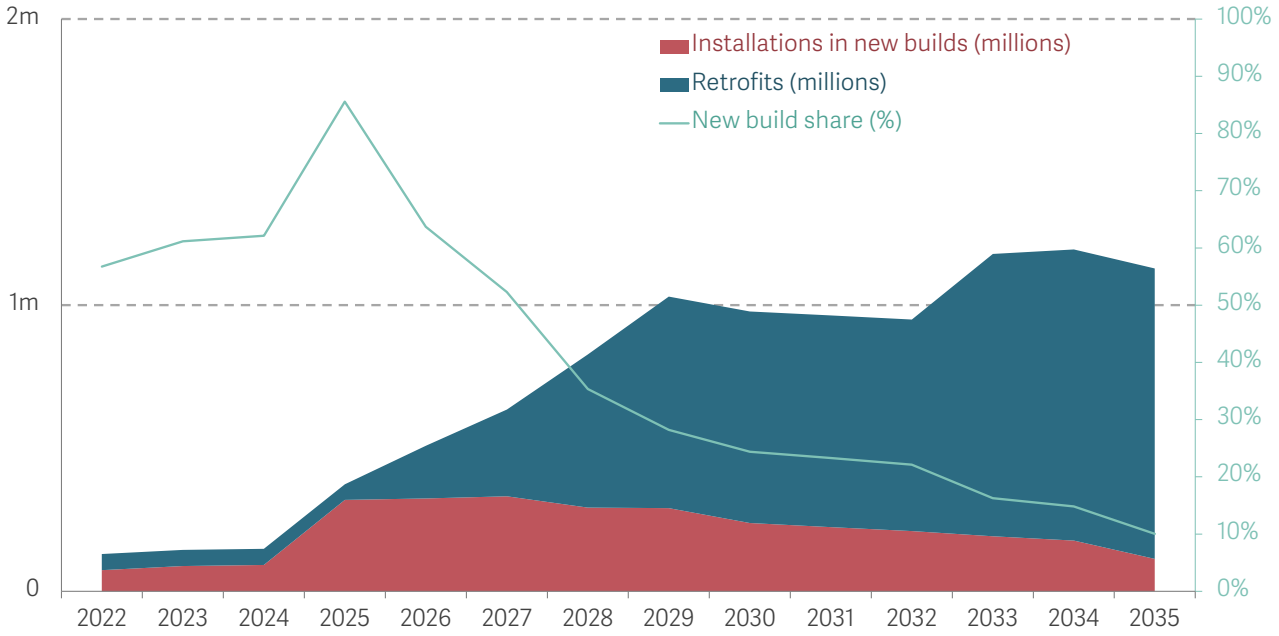
The Government strategy for clean heat is designed to encourage the market to drive down costs so that upgrades are more affordable for millions of households.

There are three aspects to this approach. First, updated building regulations will prevent new properties from being connected to the gas grid from in 2025. This will mean that new build homes will do a significant share of the early lifting on heat pump installations, accounting for 31 per cent of total heat pump installations during this decade (see Figure 3).[15] This means that a nascent sector can find its feet and train installers and mostly avoid the disruption to households associated with changing heating systems.

11 See: Heat and Buildings Strategy, UK Government, October 2021, and J Marshall, Home is where the heat (pump) is, Resolution Foundation, October 2021.
12 This share is not even across the country: North east England has the highest proportion of homes heated by gas boilers at 87 per cent while London is the lowest with 69 per cent of homes running gas-fuelled central heating, Analysis of English Housing Survey data shows.
13 There is uncertainty around the extent to which changes in behaviour will be needed, with development of high temperature heat pumps potentially reducing the need to moderate how heating systems would be used owing to colder flow temperatures. Additionally, consumer choice risks being clouded by persisting uncertainty around the extent hydrogen will be used in residential heating, with the Government recently postponing deciding until 2026. While hydrogen is unlikely to be widespread in residential heat, this policy uncertainty is likely to impact households' view of the transition. For more see: Heat and Buildings Strategy, UK Government, October 2021 and J Rosenow et al., The pathway to net zero heating in the UK, UK Energy Research Centre, October 2020.
14 Of the £9.2 billion pledged in the 2019 Conservative Manifesto, £2 billion is yet to be allocated. See: Still waiting for the green light, Energy Efficiency Infrastructure Group, November 2021.
15 See: The Future Homes Standard: changes to Part L and Part F of the Buildings Regulations for new dwellings, Ministry of Housing, Communities and Local Government, October 2019.

FIGURE 3: **Installations in new builds can get the UK's heat pump transition going**

Forecast annual heat pump installations in new and existing properties, UK



NOTES: The new build installation rate is also a function of the number of homes built per year, so if the Government moves closer to its stated aim of building 300,000 new homes per year the contribution of new homes to early heat pump installations will be greater still.
SOURCE: Analysis of CCC Sixth Carbon Budget, Department for Business, Energy and Industrial Strategy Net Zero Strategy data.

Second, the Government will support homeowners who wish to invest in their properties, initially via grants that will cover up to £5,000 of investment costs, and then through proposed regulations requiring boiler manufacturers to sell a minimum proportion of heat pumps.[16] Finally, the Government has said that regulations will prevent gas boilers from being installed in homes from 2035. The hope is that these measures together both provide firms with the long-run certainty needed to encourage innovation, increase manufacturing capacities and therefore benefit from economies and scale and learning by doing. This should generate a rapid expansion in the short-run of what is currently a very small market. These measures will contribute to lower per-unit costs for heat pumps, with the Government setting the aspiration that an installed heat pump will cost the same as an installed gas boiler by the end of this decade.

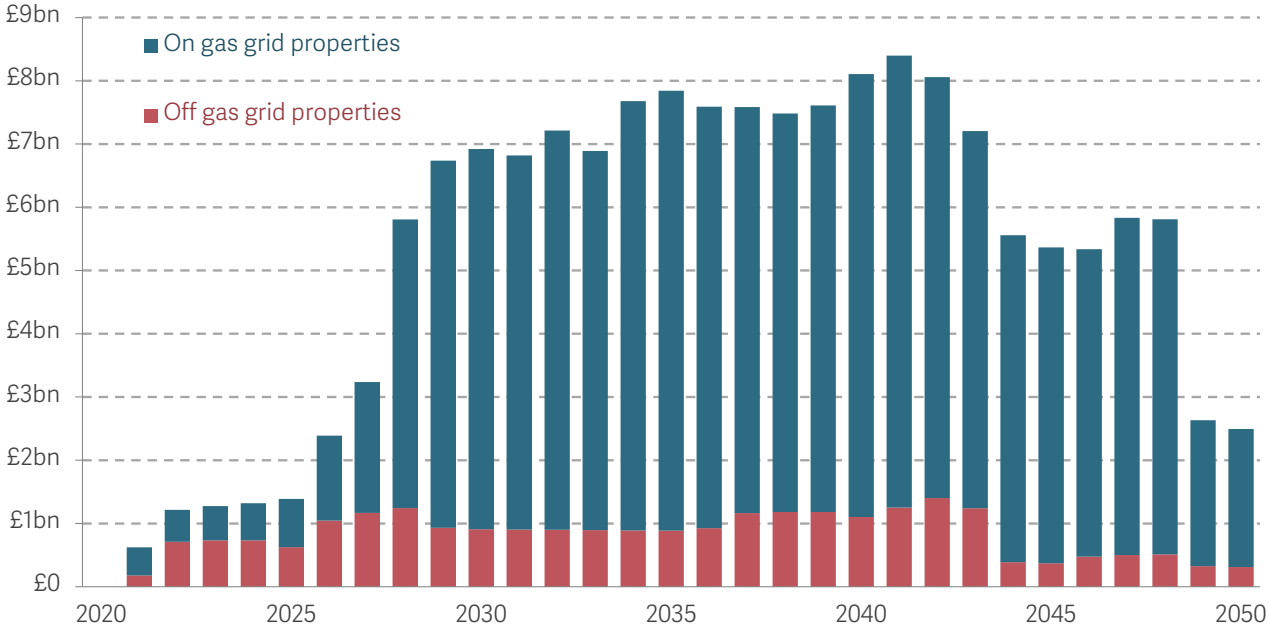
This strategy aligns with rollout levels in CCC forecasts, in which capital expenditure on heat pumps (particularly in existing homes) largely happens in the later decades on the

16 The Government's proposed Market-based mechanism for low carbon heat is set to mandate that a minimum share of heating system sales are low carbon, increasing such that 600,000 heat pumps are installed in British homes by 2028 (figure includes new builds). This regulation, the Government claims, could see a 30-fold increase in the number of domestically manufactured heat pumps. However, there remains a risk that minimum sales targets could push up the cost of legacy products (as seen following the introduction of California's zero emissions vehicle mandate), thereby making boilers more expensive for households not yet able to move to a clean heating source. Additionally, wide-ranging and effective standards will need to accompany the mandate to ensure that heat pumps are installed correctly and not hurriedly installed into homes for which they are not suitable – a particular problem arising from the UK's diverse housing stock.

UK's net zero transition (86 per cent of the forecast additional expenditure to replace heating systems in existing properties is set to come after 2030: see Figure 4). These timescales mean that, should the Government's hoped-for cost reductions not arise, there is time for a contingency plan to avoid households facing higher costs when they do come to switch from gas to clean heat.

FIGURE 4: **Heat pump investment is heavily back-loaded into the 2030s and 2040s**

CCC forecast of additional annual household investment in clean heat, UK



NOTES: More than half (54 per cent) of additional investment during the 2020s is set to be in off gas-grid properties, spurred on by a ban on new fossil fuel heating systems in these properties from 2026. The Government is set to take a 'heat pump first' approach to off gas grid homes and has announced support to assist lower income households with the transition.
SOURCE: Analysis of CCC Sixth Carbon Budget data.

This optimism on heat pump costs falling, however, is not to downplay the challenge of replacing 23 million gas boilers across households of all types, incomes and locations. Installers will need to develop new skill sets; households may need to change behaviours, given the way that heat pumps work (although 'high temperature' heat pumps are now appearing on the market); and electricity generation and network capacities will need to be beefed up to cope with additional demand. Additional issues, such as the declining use of Britain's gas network (see Box 2) will also need to be considered.

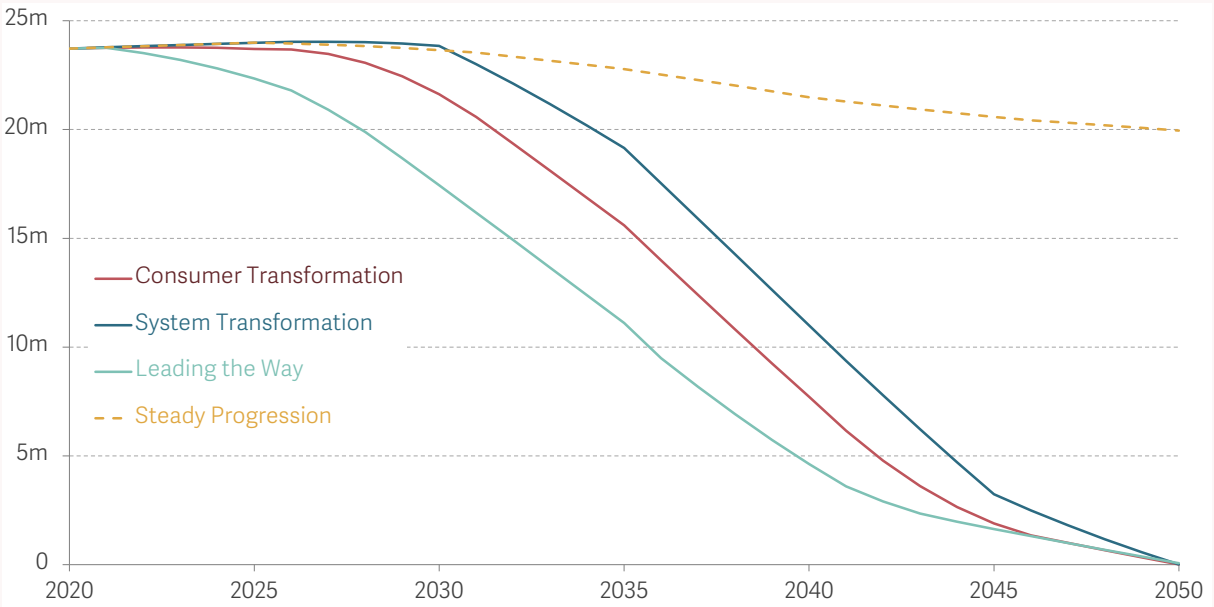
BOX 2: **Lower income households could be left footing the bill for the gas network**

The trajectory toward net zero involves rapidly reducing gas consumption, both in and outside of the home, increasing the need to face up to long-running concerns about the future of Britain's gas grid. Managing the decline of this c.£28 billion asset brings another challenge to the clean heating transition, as it is lower-income households who are more likely to be slower to disconnect from the system.[17]

As Figure 5 shows, the number of homes heated by gas could fall by 27 per cent during this decade (before the Government's hoped-for heat pump cost reductions materialise) and halve by 2035. It is likely that the majority of these would also disconnect from the gas network, as retaining a connection for cooking use would still attract the standing charge, currently around £180 per year.[18]

FIGURE 5: **Gas network demand is set to decline rapidly**

Projections of number of homes heated by natural gas under different National Grid scenarios: GB



NOTES: Three of National Grid's scenarios (Consumer Transformation, System Transformation and Leading the Way, shown in solid lines) are aligned with net zero by 2050 and carbon budgets in between. The fourth, Steady Progression which represented with a dotted line, does not.
SOURCE: Analysis of National Grid Future Energy Scenarios

17 As well as the cost of a heat pump, gas networks currently ask for a fee when households disconnect.
18 Median household cooking fuel costs (in 2019) were £43 per year, compared with £470 per year for space heating costs and £118 to produce hot water, English Housing Survey data shows.

Plans need to be made, therefore, for an equitable stranding or repurposing of the gas transmission and distribution networks, otherwise families in heat-pump equipped homes will excuse themselves of significant costs, leaving them to be borne by households unable to make the switch. There is currently little in the way of government policy or regulatory action to address this. Despite a clear implicit backing for widespread electrification of residential heat in the Government's Heat and Buildings Strategy, delaying the decision on the extent to which hydrogen will be used to heat homes until 2026, and continued investment planned in the RIIO-2 price control period, brings further uncertainty around how the decline of the gas network will be managed.

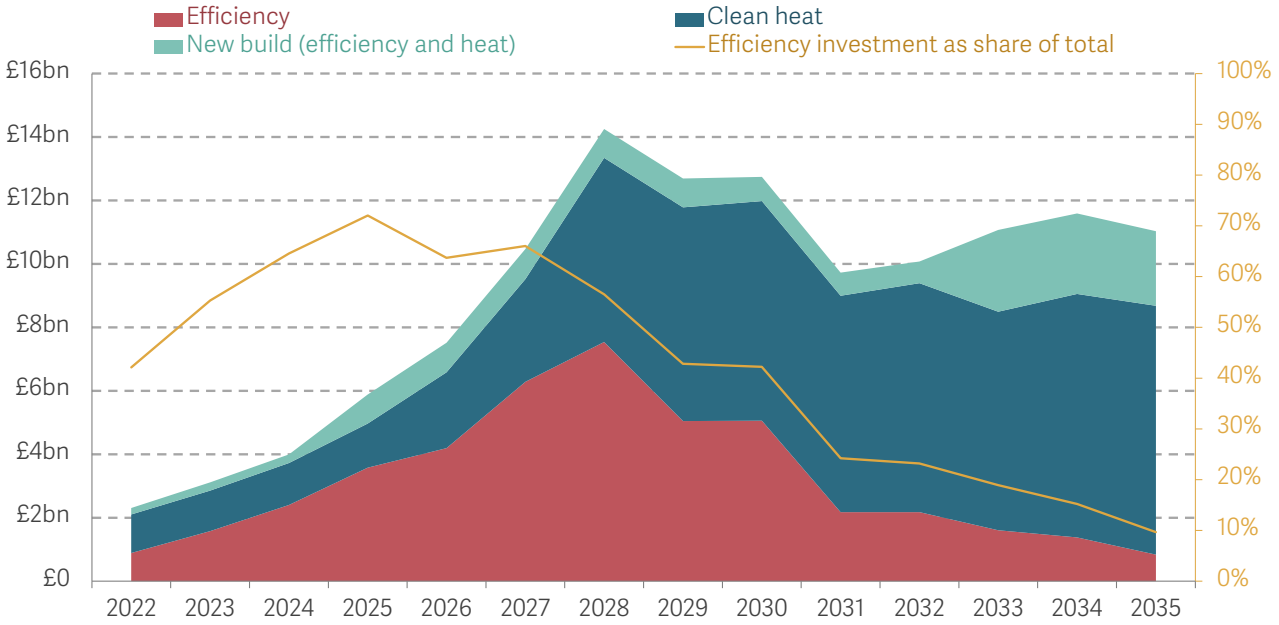
While there is a plan to switch to heat pumps, there is no strategy for insulating millions of leaky homes

In contrast to the plan for heat pumps, there is much less of a government plan to tackle the complementary problem of energy efficiency in our homes. This is concerning in light of the justification for prioritising efficiency improvements which, in the short-term can improve living standards by lowering bills even before heat pumps are installed. In the long-run, heat pumps work much more effectively and at lower costs in well-insulated homes.

This lack of action is more surprising because of the scale of investment needed in the 2020s, well before the bulk of the investment on heat pumps will happen. CCC forecasts highlight this urgency: the majority of efficiency spending (£45 billion out of a total of £55 billion) would need to take place before 2035 (see Figure 6). Insulating homes, again according to CCC figures, will account for a 70 per cent of total net zero spending on residential property in 2025.

FIGURE 6: **Required investment in insulating homes is front-loaded**

Annual additional capital investment in residential buildings: UK



NOTES: Percentage of total additional investment in existing properties shown by the yellow line, RHS axis.
SOURCE: Analysis of CCC Sixth Carbon Budget data.

The current surge in domestic energy prices has highlighted the prolonged failure to insulate the UK's housing stock. A family living in a typical property rated E on the EPC scale consumes, on average, 48 per cent more gas for heating per year than an equivalent C rated home. On current (winter 2021-22) prices, this corresponds to additional costs of £190 per year but, when the price cap is increased in April, this 'efficiency gap' will jump to £320.[19] Across all 16 million British homes that are rated D or below on the EPC scale, this additional spending on energy jumps from £2.3 billion under current prices to £3.9 billion.

The Government currently has a stated aim of insulating all homes to an EPC rating of C 'where practical, cost-effective and affordable'.[20] The Government also has a fuel poverty targets to upgrade all fuel poor homes to an EPC C rating by 2030, with an interim target in 2025 of reaching band D.[21] The immediate challenge associated with decarbonising the housing stock, a major determinant of how households interact with net zero policy during the 2020s, is turning these targets into delivery.

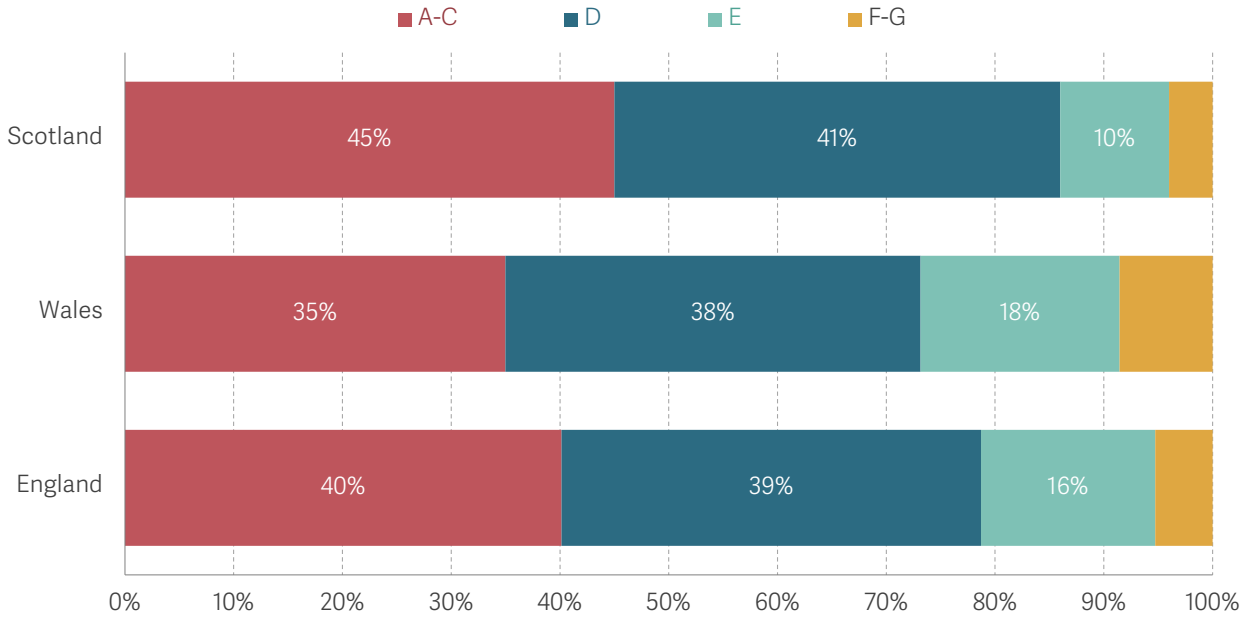
19 Based on Department for Business, Energy and Industrial Strategy National Energy Efficiency Data Framework data showing gas demand for an EPC C rated home of 9,600 kWh/year and 14,200 kWh/year for an EPC E rated property and a retail gas price of 4.1 pence per kWh, in line with that under the winter 2021-22 standard variable tariff price cap. Gas unit costs are set to increase by 69 per cent in April and electricity by 42 per cent, combining to an overall increase in the price cap of 54 per cent.
20 This target was first set in: Clean Growth Strategy: Leading the way to a low carbon future, UK Government, October 2017.
21 See: Committee on Fuel Poverty annual report 2021, October 2021.

The UK has an old and heterogenous housing stock – insulating it will not be straightforward

Insulating homes, however, is a far from a simple task. First, the scale of the challenge will see many households impacted: more than half of households in England (60 per cent) and Wales (65 per cent) live in homes rated below EPC C and will therefore need upgrading by 2035 (Figure 7). In Scotland, where efficiency policies are largely devolved, 55 per cent of properties will need insulating before the slightly more ambitious 2033 deadline.[22]

FIGURE 7: **Much of the nation's housing stock falls short of energy efficiency targets**

EPC ratings of properties in Scotland, Wales and England



NOTES: England and Wales data is 2021, Scotland is 2019
SOURCE: Analysis of ONS English Housing Survey data, Scottish House Condition Survey.

The UK's housing stock is highly diverse, with different property types, tenures, locations, occupant profiles and numerous other factors hindering a 'one-size-fits-all' approach. For example, privately rented and owner-occupied homes are much more poorly insulated than social housing, with 58 per cent of properties in both tenures rated at EPC D or below.[23] Socially rented homes are more efficient, because they are generally newer, and include more flats, with housing associations also receiving public funding to support upgrade costs.[24] Although there has been some improvement in owner-occupied homes in recent years – most likely driven by private investment in properties when modified

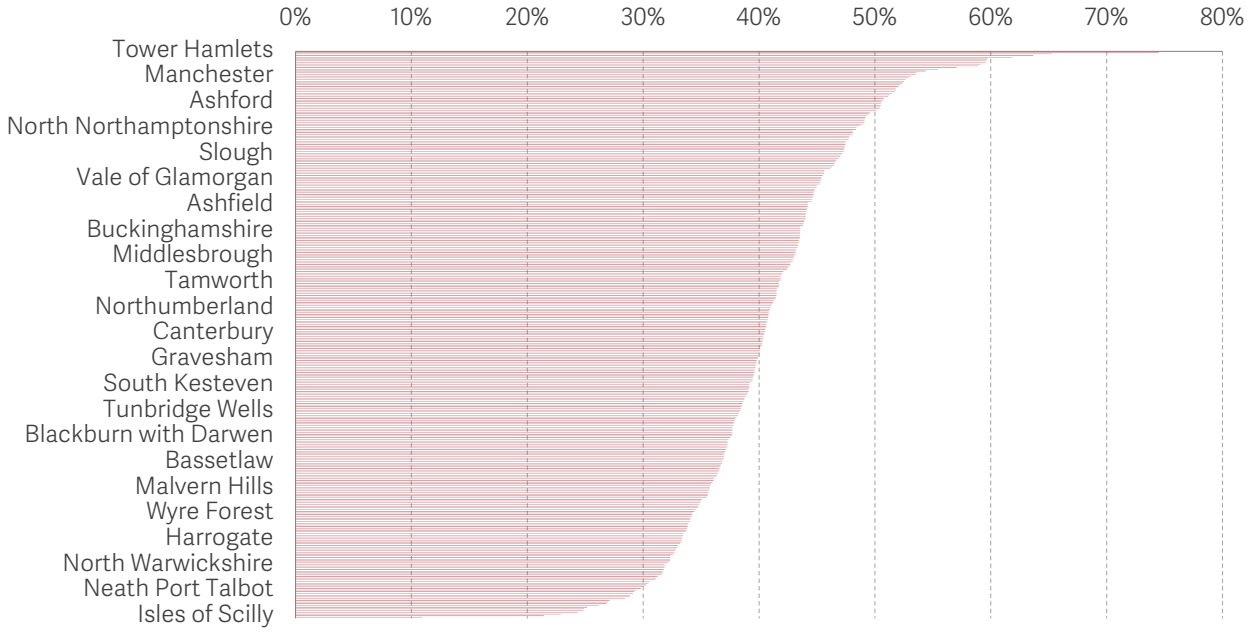
22 For more information, see: Heat in Buildings Strategy: achieving net zero emissions in Scotland's buildings, Scottish Government, October 2021.
23 See: English Housing Survey, Headline report 2020-21, Department for Levelling Up, Housing and Communities, December 2021
24 The Government has started delivering funding to both private and local authority housing providers via the Social Housing Decarbonisation Fund, a ten-year, £3.8 billion scheme to reduce emissions from socially rented homes.

or renovated – there has been less change in existing properties in the PRS.[25] Analysis of efficiency improvements by income also paints a worrying picture, with properties occupied by wealthier households showing a greater rate of improvement than those lived in by less well-off families.[26]

Geographically, Figure 8 shows how building efficiency varies across local authorities. Just 11 per cent of families in the Isles of Scilly live in homes rated at EPC C or higher, compared with 75 per cent of those in Tower Hamlets (and a median of 40 per cent). Property types and ages are the main drivers of this disparity,[27] with better performance in newer homes (66 per cent of homes built since 1980 are A-C rated, compared to 10 per cent constructed before 1919) and in purpose-built flats (72 per cent of high-rise purpose-built flats are A-C rated, compared with 26 per cent of semi-detached houses).[28]

FIGURE 8: **There is significant geographical disparity in the energy efficiency of housing**

Proportion of homes with an EPC rating of 'C' or higher, by local authority, 2020-21: England and Wales



NOTES: All local authorities shown but only a small number are highlighted on the y-axis for illustrative purposes.
SOURCE: Analysis of ONS English Housing Survey data.

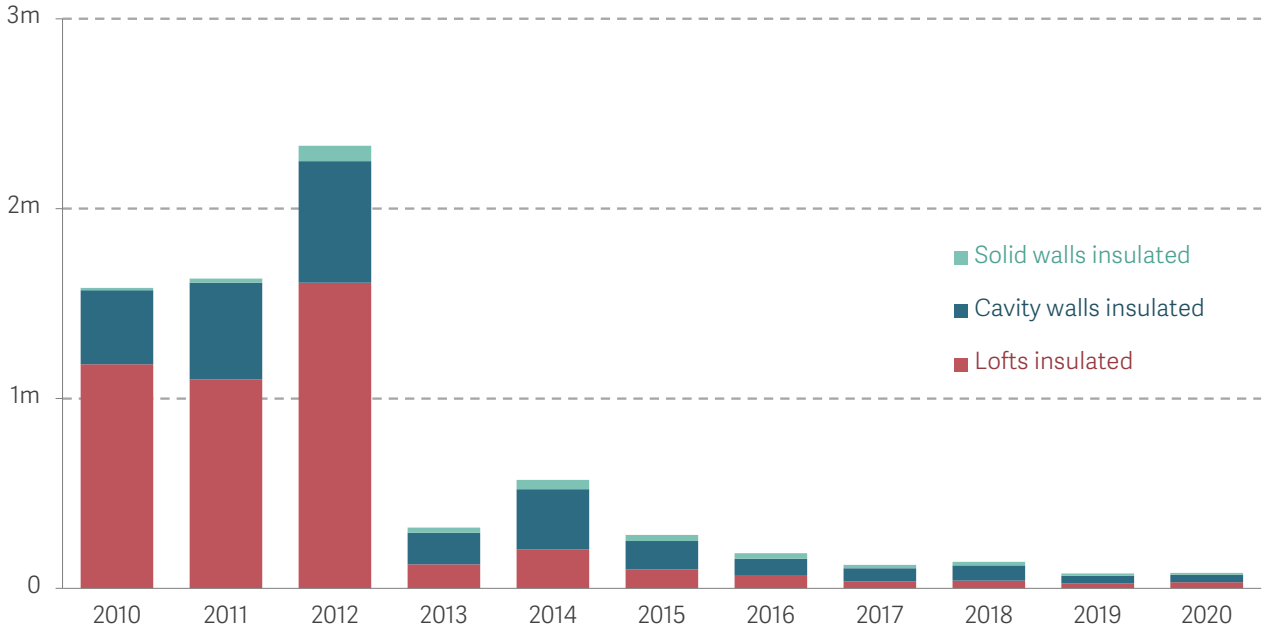
25 See: J Marshall, Home is where the heat (pump) is, Resolution Foundation, October 2021
26 See: J Marshall & A Valero, The Carbon Crunch: Turning Targets Into Delivery, Resolution Foundation, September 2021
27 See: Age of the property is the biggest single factor in energy efficiency of homes, ONS, January 2022.
28 Source: analysis of English Housing Survey

Years of inaction have made the insulation challenge harder still

The parlous state of the nation's homes, and the distance still to go, are to a large extent the result of policy decisions. Back in 2012, more than 2 million insulation 'measures' (loft insulation, cavity wall insulation, etc) were being installed in British homes per year (see Figure 9). However, decisions made in the early 2010s to end the Warm Front programme and reduce funding for the Energy Company Obligation (amid political pressure associated with rising energy bills) saw this progress fall by 90 per cent, virtually overnight.[29] While the average efficiency of the housing stock has increased, albeit slowly, since then, some improvements have been driven by the construction of new homes, which are more efficient than the average property. Continuing at the pre-2012 pace over the ten years since would have seen upward of 18 million insulation measures installed in Britain's homes; it has been estimated that this pause on energy efficiency means that 9 million households are paying an extra £170 per year on energy bills.[30]

FIGURE 9: **Policy decisions stopped decent progress on insulation in its tracks**

Home insulation installations by year: GB



SOURCE: CCC Progress Report 2021.

This dramatic falloff is the result of a 2013 step change in British energy efficiency policy, in which the Carbon Emissions Reduction Target (CERT) – a requirement on energy suppliers to reduce domestic energy use – was replaced with the Green Deal, a scheme in which voluntary upgrades were financed via an on-bill charge. This shift in strategy

29 It should be noted that, since the 2008 financial crisis, household energy bills have only recently begun to rise, with fluctuations in unit prices during the 2010s – particularly those resulting from the 2010-14 commodity cycle – roughly cancelled out by falling energy use at home. For more information, see: Energy Prices and Bills, Climate Change Committee, March 2017, and: J Marshall, Energy bills – here we go again, Energy and Climate Intelligence Unit, March 2017.

30 See: S Cran-McGreehin, Insulation and gas prices, Energy and Climate Intelligence Unit, undated.

from a regulation-based to a voluntary model meant that further progress would be entirely demand-led, with no minimum delivery targets. Additionally, the winding down of the Warm Front programme left the UK with no publicly-funded insulation scheme for low-income households for the first time in over 30 years.

Since this plummet, efficiency upgrades have largely been delivered through the well-targeted but under-resourced (and bill-payer funded) Energy Company Obligation (ECO), or through private investment, initially catalysed via the Green Deal and more recently through the Green Homes Grant. Both of these schemes started off with lofty ambitions: the Green Deal had goals of insulating as many as 14 million homes by 2020, reaching a rate of 2 million installations per year, and the Green Homes Grant aimed to deliver 600,000 upgrades in just six months from a standing start.

Neither succeeded. The number of 'completed' Green Deal plans stands at just 3,700, and the Green Homes Grant fared only slightly better, upgrading around 47,500 homes and failing to spend four-fifths of its original £1.5 billion budget.[31] A series of post-mortems have analysed the failings of energy efficiency policies. High interest rates (as much as 7.5 per cent) coupled with the 'Golden Rule' (whereby cost savings from upgrades needed to be greater than installation costs) were found to be major failings in the Green Deal.[32] The Green Homes Grant was stymied by an onerous application process and a lack of accredited tradespeople to carry out work, preventing it from meeting the significant consumer demand for it when launched.[33] One common trait, though, was the reliance on households voluntarily participating in, and part-funding, efficiency programmes, with no minimum regulations to drive progress. When compared with progress made by the (albeit pared-back) regulation-led ECO scheme running at the same time, it can be argued that the shift in government strategy is a key factor behind unacceptable progress on insulating homes over the past decade.

This slow progress means that UK home-owners have a considerable task ahead of them, a challenge made more daunting by the focus of Exchequer support on socially rented homes and public sector buildings.[34] Meeting the Government's 2035 EPC C target would require 40 million insulation measures to be installed over the next 13 years. For comparison, the average number of measures installed across the three years prior to the pandemic was less than 150,000: failing to improve on this rate would see a shortfall of 38 million (a 95 per cent gap on what is needed) by the middle of the next decade.

31 See: Headline Energy Efficiency Statistics, Department of Business, Energy and Industrial Strategy and: Green Homes Grant Voucher Scheme, House of Commons Committee of Public Accounts, November 2021.
32 See: J Rosenow & N Eyre, Re-energising the UK's approach to domestic energy efficiency, Regulatory Assistance Project, June 2015, and: Green Deal and Energy Company Obligation, National Audit Office, April 2016.
33 See: Green Homes Grant Voucher Scheme, House of Commons Committee of Public Accounts, November 2021, and: Poll shows demand for Green Homes Grant set to outstrip supply, Energy and Climate Intelligence Unit, September 2020
34 The Government has pledged some support for decarbonising buildings, but it is mainly set to fund socially rented homes or public buildings. For more see: J Marshall, Home is where the heat (pump) is, Resolution Foundation, October 2021

Meeting this target is a complex and varied challenge, and is therefore best broken down into smaller parts. One approach could be to address different housing sectors in turn. As we said above, social housing is already more efficient than privately rented or owner-occupied housing, and improvements are the responsibility of (large) landlords, and some public funding is available. As such, it is not the focus of this paper. The next sections will therefore address the tasks of insulating privately rented and owner-occupied properties.

If enacted, regulations for the private rented could drive change

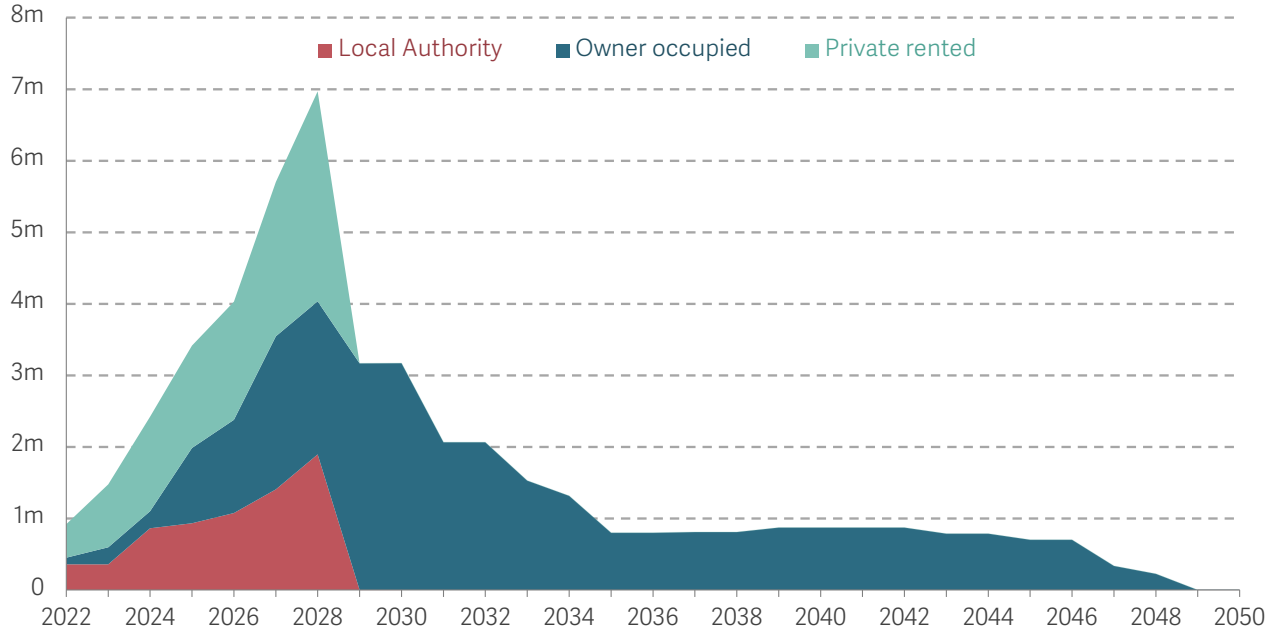
One glimmer of light in the otherwise gloomy picture facing households, however, is proposed efficiency standards for privately rented properties.[35] The UK's 13 million private rented sector (PRS) tenants have long been housed in inefficient homes, with just a 7 percentage point increase in the proportion of PRS homes rated EPC C or higher from 2014 to 2019.[36] However, proposed new minimum efficiency standards that will require PRS properties to achieve this C rating for new lettings from 2025 and for all lettings from 2028 could, in theory, see upward of 2.8 million properties in England and Wales upgraded in just a few years – a near seven-fold increase in pace.[37]

Such a regulation would also be in line with CCC advice, and would drive the surge in energy efficiency installations shown in Figure 10. Having the PRS kickstart a decade of delivery would lead to major benefits: greenhouse gas emissions from PRS properties total 11 million tonnes, or 16 per cent of the total from Britain's homes[38] and – crucially for living standards – would see the homes of more than 8 million people improved during the next six years.[39] Lower energy bills would be felt immediately by parts of society over-represented in the PRS: younger people (57 per cent of 16-29 year olds live in the PRS) and ethnic minority households (29 per cent of whom live in the PRS, compared with 18 per cent of white households).[40]

35 See: Improving the Energy Performance of Privately Rented Homes in England and Wales, Department for Business, Industry and Industrial Strategy, September 2020.
36 See: J Marshall & A Valero, The Carbon Crunch: Turning targets into delivery, Resolution Foundation, September 2021
37 Based on 60 per cent of the 4.6 million PRS homes in England and Wales that are rated EPC D or below. Current plans in Scotland will see all PRS homes needing to attain an EPC D rating at the point at which tenancy is changed from April 2022. Despite this tight time frame, recent media reports suggest PRS regulations could be delayed by a year, see: M Lawford, Landlords granted reprieve on costly eco upgrades, Daily Telegraph, December 2021.
38 Residential sector greenhouse gas emissions were 69 million tonnes in 2019, Government data shows.
39 There are 13 private million renters in the UK, roughly one fifth of the overall population. Source: About renting, Generation Rent.
40 Source: English Housing Survey. Ages refer to Household Reference Person, the member of the household in whose name the property is owned or rented, or is otherwise responsible for the accommodation.

FIGURE 10: **Tough regulations could see the rented sector drive an efficiency surge**

Forecast annual energy efficiency installations in residential property by tenure in the CCC's Balanced Pathway: GB



NOTES: Efficiency investment and installations in line with the CCC Sixth Carbon Budget Balanced Pathway assumed. Imposing PRS regulations later, as recent media reports have suggested, as well as continued lack of support and incentives for local authority and owner-occupied properties would see a different route to achieving a well-insulated building stock.
SOURCE: Analysis of CCC Sixth Carbon Budget data.

Additionally, short tenancy lengths observed in the PRS mean that the impact of regulations on new tenancies would rapidly spread across the tenure: 40 per cent of private sector tenants have lived in their home for a year or less, and 70 per cent have moved in the past five years. For this reason, the CCC expects that a minimum efficiency standard in 2025 would mean that that 65 per cent of all PRS upgrades would be made before the end of 2027, leaving around 1 million homes (2.8 million efficiency installations) for the 'final push' in 2028.

Of course, such a rapid pace of delivery – peaking at more than 130,000 installations per week – leads to risks of there being an insufficient workforce or materials to deliver this (the potential halving of demand for the services of tradespeople in just 12 months will also reduce the likelihood of the installer work base growing at the requisite pace in the first place).

Another inherent risk with regulating the PRS is enforcement. Although regulation-based efficiency schemes delivered large numbers of upgrades in the past, the PRS has long-suffered from weak enforcement of standards and regulations, and so an improvement in

adherence, particularly at the lower end of the market, will be needed.[41] Overall, though, obliging landlords to improve their properties would also see a significant number of homes improved at minimal cost to the public purse.[42]

Poorer owner occupiers continue to be overlooked

Two thirds of homes in England are owner occupied, with tenure-wide improvements in thermal efficiency in line with the sluggish progress seen in the PRS. Although home ownership is more common as we move up the income scale, nearly one third (30 per cent) of the poorest fifth of households own their own homes, either outright or with a mortgage.[43] In the continued absence of a state-funded scheme to help with upfront costs, it is these households, with a mean annual after housing costs income of just £9,100,[44] who will find it very difficult to insulate their properties without financial assistance.[45]

Of this low-income but property-owning group, 72 per cent live in homes rated EPC D or below, with one fifth (18 per cent) in properties built before the first world war – the hardest (and most costly) homes to insulate.[46] The average cost for bringing an owner-occupied D-G rated home up to C standard is estimated at £8,580 per household (although this range will be skewed significantly by high cost outliers, with modelling carried out for the CCC concluding that two-thirds of UK homes would need less than £1,000 of investment to reach EPC C standard).[47] Even at this low end, investment of this scale will not be affordable for the poorest homeowners.

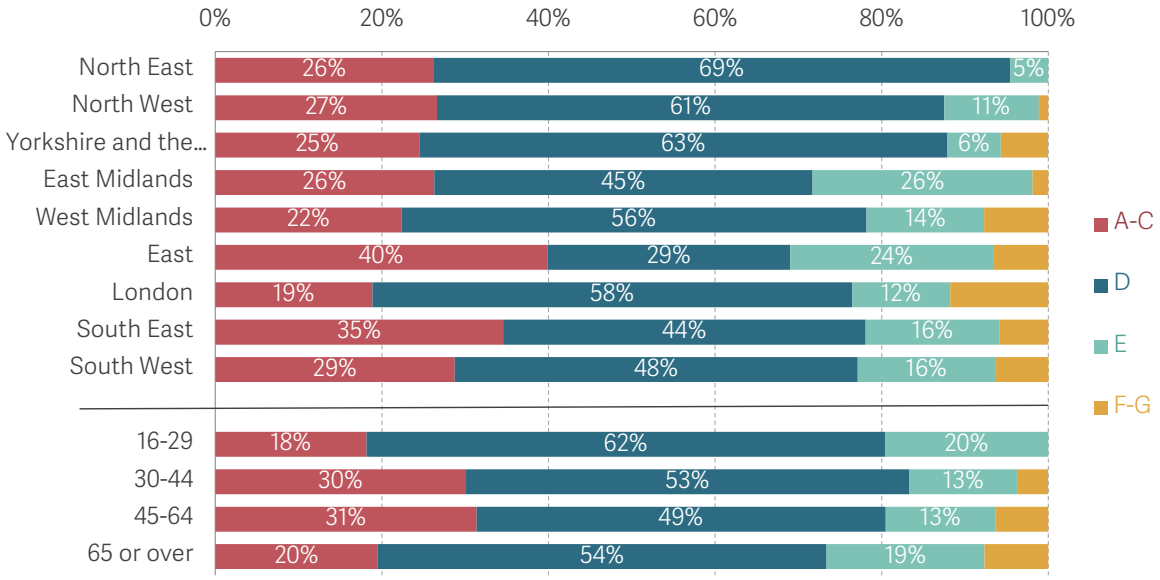
As with most insulation challenges, there is also a significant geographical variation. As Figure 11 shows, London has the greatest share of poor owner occupiers whose homes are rated below EPC C, with the East of England and East Midlands having the highest share of the very worst-performing homes. As ever with housing, there is also a generational variation: low-income homeowners under 30 or over 65 are less likely to live in more efficient housing than those between 31 and 64. This split highlights the need for a considered policy response, as pension-age households and those starting off in life

41 See: J Harris, D Cowan & A Marsh, Improving compliance with private rented sector legislation, UK Collaborative Centre for Housing Evidence, August 2020.
42 There is a risk that mandating investment could see landlords exit the market, particularly in areas with lower property values and lower levels of rent. Landlords may also increase rents to try to recoup their outlay, but any affected tenants should benefit from reduced energy costs.
43 Analysis of English Housing Survey data shows that 30 per cent of the lowest after housing costs income quintile are owner-occupiers, compared with 88 per cent of the highest-income quintile. This trend mirrors age-related patterns in home ownership, with gaps in home ownership between younger and older cohorts increasing in recent years. For more information, see: A Corlett & F Odamtten, Hope to Buy: The decline of youth home ownership, Resolution Foundation, December 2021.
44 HBAI gives a slightly lower figure of £8,400 than that quoted in the text, which comes from the English Housing Survey.
45 Some support is available for low income homeowners through the Energy Company Obligation (ECO), a billpayer-funded policy targeted at households in fuel poverty. A new phase of the scheme, ECO4, is set to start in April 2022 with £1 billion funding for efficiency upgrades.
46 Analysis of English Housing Survey data shows that 19 per cent of owner occupying households in the lowest after housing costs income quintile live in homes constructed before 1918, compared with 14 per cent in homes built since 1981. As discussed earlier, property age is one of the main drivers of variations in building energy performance.
47 ONS analysis found that the mean cost of uprating owner-occupied homes is the highest of all tenures. This research uses the Energy Efficiency Rating (EER) scale instead of EPC, although in this instance the two measures are broadly comparable. The wide range of costs emanates from 2021 research carried out by Element Energy for the CCC.

will have very different financial priorities, and will react to different incentives in different ways.

FIGURE 11: **The need to insulate the homes of poor owner occupiers comes with significant geographical and age-related challenges**

Property energy efficiency ratings for owner occupier households in the bottom after housing costs income quintile, by region and age of household reference person: England



SOURCE: Analysis of ONS English Housing Survey data.

At present, the Government is leaning on demand-led policies that include mixtures of public and private investment to fund efficiency upgrades. Tools such as green mortgages – under which lower rates or additional borrowing is made available to families looking to upgrade their homes – are not likely to work for lower-income households, who have lower levels of savings and are more likely to be in debt, or are not suitable for loan products. Without assistance to insulate their homes, it is these households that will be limited in terms of options for clean heat, as well as facing prolonged exposure to higher energy bills.

This Section has set out the key challenges that households face as the UK looks to decarbonise its housing stock. It has argued that, for all the current focus on heat pumps, the 2020s will need to be a decade of delivery in energy efficiency. Bringing about investment, both public and private, to improve the thermal performance of homes will shield families from higher energy bills and ensure properties are prepared for clean heat installations beginning in earnest in the 2030s. What is lacking, though, are comprehensive policies to support the required level of insulation, especially for lower-income homeowners. In the next section, we look at the challenges and opportunities associated with another consumer-facing transition: the move to electric cars.

Section 3

Ensuring the benefits of electric vehicles are available to everyone

The electrification of surface transport is already well underway in the UK, with electric cars an increasingly common sight on the nation's roads, and on their way to mass market. This is welcome progress, particularly as the quicker-than-anticipated changes taking place in the vehicle stock are being driven by falling costs. The 2020s, however, will need to be a decade in which the rollout of clean transport continues to accelerate, with emissions from surface transport needing to fall by three-quarters by 2035 to meet our net zero targets.

Similar to housing, decarbonisation of transport breaks down into two core elements: replacing the 32 million cars on our roads with electric alternatives, and building a complementary charging network. Both of these will involve up-front investment that will unlock savings for households in the form of cheaper running costs. Of the two elements, the dramatic fall in the cost of electric cars – which now account for one in five of UK car sales, easily outpacing expectations – means that investment in the vehicles themselves will not be a big living standards issue for the 2020s. Instead, policy makers should focus attention on ensuring fair access for all to the low-cost charging that allows all households to unlock the greatest savings.

Two-thirds of British households will be able to charge cars at home, but those without sufficient parking provision – more commonly observed in lower-income households and renters than in higher-income families and owner occupiers – will need to rely on the unevenly distributed and variably priced public charging network. And the price difference is considerable: drivers utilising at-home charging could see their annual fuel cost fall from around £1,100 for a petrol car to a cost of just £389. This could drop further, to around £139, if refuelling is done using low-cost overnight tariffs, and even more savings can be banked by using smart 'vehicle-to-grid' technology, resulting in fuel costs of less than £40 per year. Households with no choice but to

use the public network will still see savings compared to fossil fuel vehicles, but to a smaller scale, with a typical annual cost of £712 (assessed across a basket of charge point operators). This is partly due to differential tax treatment – VAT is levied on home electricity at 5 per cent, compared to 20 per cent on the public network – but there are also concerns about a lack of effective competition that would otherwise drive down costs.

In addition to accessing fair prices, drivers need to be able to physically plug their cars in. Currently the distribution of electric chargers varies significantly across the country: this causes difficulties for existing EV drivers, and makes EVs less appealing for those yet to make the switch in low-capacity areas. Private investment in public charging has, understandably, followed demand, with more chargers in areas with more electric cars. This has led to wide ranges in the ratio of overall cars:chargers, a key metric in providing confidence for households to switch: there are 44 cars per charger in Westminster to 16,400 cars per charger in Essex's Castle Point (and no public chargers at all in the Isles of Scilly). Addressing this regional disparity is key to ensuring that the 'S-curve' trajectory upon which electric car sales are travelling does not slow, and that households all across the UK are able to reap the savings from driving electric cars.

The move to electric cars, vans and motorbikes will be a high-profile and visible change for households in the net zero transition. As with the move to clean heating, the impacts of electrifying transport on households' living standards has two parts: investing in electric cars needed to replace the 32 million petrol and diesel cars currently on UK roads, and ensuring that households are able to bank their fair share of savings that result from lower motoring costs through access to low-cost vehicle chargers.

The extent of change in the 2020s will be sizeable: emissions from surface transport are the largest contributor to the UK's territorial carbon footprint, needing to fall by 73 per cent by 2035 in order to meet the sixth carbon budget.[48] Meeting this goal will require widespread take-up and use of cleaner modes of transport. Fortunately, policies that will allow households to make the transition to electric cars are relatively well developed and clear. New regulations will prevent the sale of fossil-fuelled cars and vans from 2030 (and hybrids from 2035), grant funding has been available to aid with the upfront costs of vehicles and charging equipment, consumers can access tax benefits including exemption from Vehicle Excise Duty (VED) and salary sacrifice schemes, and both the public and private sector is investing in charging infrastructure. However, although

48 Note that modal shift – replacing journeys made by private vehicles with public or active transport – will also contribute to decarbonising surface transport. In fact, accelerating the shift away from private transport is listed as one of the Government's 'Strategic Priorities' in its 2021 Transport Decarbonisation Plan. Reduced car travel will also lead to less congestion, less air pollution, and provide a downward pressure on running costs for drivers able to get to their destinations using less fuel. As such, investment in public transport, in cycling and walking infrastructure, and continued uptake in car clubs all have a significant role to play. This report, though, focuses on the direct impact on household incomes.

policies to incentivise uptake are clear, more attention is needed on ensuring that the financial benefits of electric vehicles – predominantly lower running costs than petrol and diesel cars – are shared equally. These savings are set to total £124 billion over the 2022-35 period, according to CCC projections, but risk being made available to different extents to different people.

This Section will look through these two aspects of the transition in turn, first examining changes in the vehicle stock before assessing developments in charging infrastructure.

Changes in the vehicle stock are outpacing expectations

Rapid technological change is not a new phenomenon; therefore, it is not entirely surprising that the uptake of electric vehicles is outpacing expectations. In 2021, battery electric vehicles constituted one-in-nine of all UK car sales, an increase of more than 75 per cent on 2020 figures, with uptake increasing further in early 2022: one in five new cars on the road now comes with a plug.[49] As Figure 12 shows, electric car sales are now outpacing even the most ambitious scenarios, with the share of sales more than ten times greater than in the OBR's 2019 forecast and more than two years ahead of the CCC's more ambitious 'tailwinds' scenario.[50] Voluntary demand from those households for whom electric cars are affordable is driving rapid change in the vehicle stock, and so it seems likely that the pace of change in the UK vehicle fleet will not be the main issue for living standards caused by decarbonising surface transport.[51]

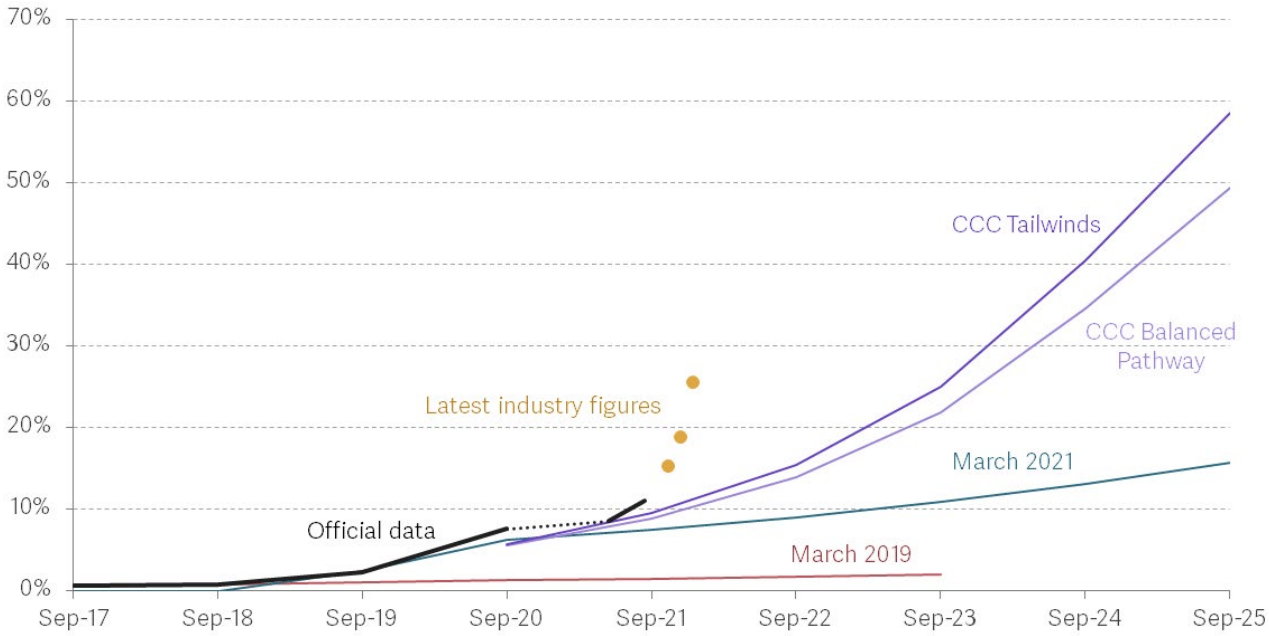
49 Industry data from the Society of Motor Manufacturers and Traders (SMMT).

50 Quicker uptake of electric vehicles is good news for reducing emissions, but it hastens long-standing questions around the stability of the UK's tax base, particularly the £35 billion in annual revenues raised from fuel and vehicle excise duty. Indeed, recent estimates are that the accelerated uptake of EVs through the 2020s could lead to an £8 billion hole in Exchequer revenues by 2030. This issue is discussed in more detail in: K Shah, J Smith & D Tomlinson, Under Pressure: Managing fiscal pressures in the 2020s, Resolution Foundation, February 2022.

51 In addition to direct impacts on household cost of living, the electrification of transport could bring growth opportunities in UK manufacturing. See: S Unsworth et al., Seizing sustainable growth opportunities from zero emission passenger vehicles in the UK, LSE Growth Commission, February 2020.

FIGURE 12: **Electric car sales are outpacing the most optimistic scenarios**

Outturn and projections for battery electric vehicles as a share of new car sales: UK



NOTES: Data points plotted at mid-point of relevant time period. Latest industry figures as published by SMMT, monthly data for October, November and December 2021. Official data as published by the Department for Transport, annual data for financial years 2017-18 to 2020-21 and quarterly data for Q2 2021 to Q4 2021. CCC forecast is published in calendar years; an estimated financial year forecast is shown here.
SOURCE: OBR, Fiscal Risks Report, July 2021; Department for Transport, Vehicle Licensing Statistics, 13 January 2021; Society of Motor Manufacturers and Traders, Car Registrations, various; CCC, Sixth Carbon Budget, December 2020.

A key driver for this growth in sales has been the rapid decline in the price of electric cars. This is a result of both supply-side drivers alongside policies and regulations that have boosted demand. These include public investment into research and development and into manufacturing facilities,[52] and regulations, such as the 2030 ban on petrol and diesel car sales, and the impending 'Zero Emissions Vehicle' mandate that will, from 2024, set targets for a minimum percentage of manufacturers' annual car and van sales to be zero emissions.[53] Additionally, households have, since 2011, been able to offset some electric vehicle purchase costs through the 'Plug-in Car Grant', although the rapid roll-out of EVs mean that this is now being scaled back from an initial £5,000 discount per vehicle to £1,500, and only for low emission vehicles with a sales price below £35,000.[54]

52 For example, UKRI has invested more than £330 million into battery research (see: Faraday battery challenge, UKRI, October 2021), and a proposed 'Gigafactory' in Blythe has received an in principle offer state funding through the Government's Automotive Transformation Fund (see: Government backs Britishvolt plans for Blyth gigafactory to build electric vehicle batteries, Department for Business, Energy & Industrial Strategy, January 2022).

53 The 'ZEV mandate' was announced in the Government's 2021 Net Zero Strategy. Full details on the scheme have not yet been released but, if administered correctly and set with sufficient ambition – any future trajectory would need to be at least in line with the CCC's targets of half of new car sales to be battery electric by 2025 and more than 70 per cent by 2028 – the ZEV mandate could shift the cost of incentivising electric vehicle take-up from the public purse onto producers (if it reduces profit margins) or those buying fossil-fuel cars (if the policy encourages manufacturers to cross-subsidise).

54 See: Low-emission vehicles eligible for a plug-in grant, gov.uk.

Uptake of electric cars remains concentrated in wealthier areas, but used electric cars will soon be accessible to lower-income households

Car ownership increases with household incomes,[55] so it is not surprising that electric cars (which are newer than the average car, as well as typically selling at a premium) are more common in more affluent areas, as Figure 13 shows. Survey data suggest that this trend will persist, with 28 per cent of households with an annual income of £100,000 or more saying they are likely to buy a lease an electric car for their next vehicle, compared with 7 per cent of households with an annual income of less than £26,000.[56]

FIGURE 13: **Plug-in cars are more prevalent in higher income areas**

Privately licenced plug-in vehicles per 100 households across local authority areas, by gross disposable income per head: UK

NOTES: City of London and Kensington & Chelsea not shown as disposable household incomes do not fit on this scale.
SOURCE: Analysis of ONS, Department for Transport data.

This increased take-up among wealthier households is predominantly a result of global falls in electric vehicle prices that have made new vehicles more affordable, but these richer first-movers have been able to benefit from publicly-funded policies that will not be available to the same extent to others. At first glance, this seems inequitable. On the other hand, there is a clear need for someone to purchase new EVs so that they can eventually feed through to the second-hand market, where they will be more suitably priced for lower-income households.[57]

55 See: J Marshall & A Valero, The Carbon Crunch: Turning targets into delivery, Resolution Foundation, September 2021
56 See: Transport and Transport Technology Public Attitudes Tracker, Department for Transport November 2021
57 The average car loses 60 per cent of its value in just three years, according to AA data.

And this should happen soon. Given that three quarters of new cars are now sold via a leasing deal, new cars are typically sold on after 2-4 years, so electric vehicles will, in just a few years, make up more than the 1 per cent of used car sales they do today.[58] Although the cost of new electric vehicles is falling rapidly (and will continue to do so), having richer motorists continuing to shoulder depreciation costs is a key step in allowing those on lower incomes to access the lower running costs of EVs (which we will come to later). Meanwhile, a greater number of electric cars on UK roads will benefit households in other ways, as we discuss in Box 3.

BOX 3: **Cleaning up the UK's dirty air would reduce inequality**

The benefits of decarbonising transport will be more than just financial. Surface transport is a major source of air pollution, accounting for a third of nitrogen oxides (NO_x) emissions and more than a tenth of particulate matter (PM2.5 and PM10) emissions, largely concentrated in urban areas. The electrification of surface transport would see the trend of falling NO_x emissions from road transport - down 73 per cent from 2009 to 2019 - continue, although increased vehicle weights of battery-powered cars could see particulate matter emissions from brake and tyre wear and from road abrasion increase.[59]

There is a clear trend of households in low income urban areas being more exposed to harmful levels of air pollution that those who are better off.[60] This is a result of numerous drivers – housing type and location, outdoor levels of pollution, internal pollution sources, time spent indoors, underlying health conditions, and more – many of which are outside of the control of those breathing dirty air.[61] This systemic inequality means that lower income households have limited opportunities to improve the quality of the air they breathe and are disproportionately burdened with a range of health conditions, ultimately being over represented in the c.30,000 annual UK deaths attributed to poor air quality.

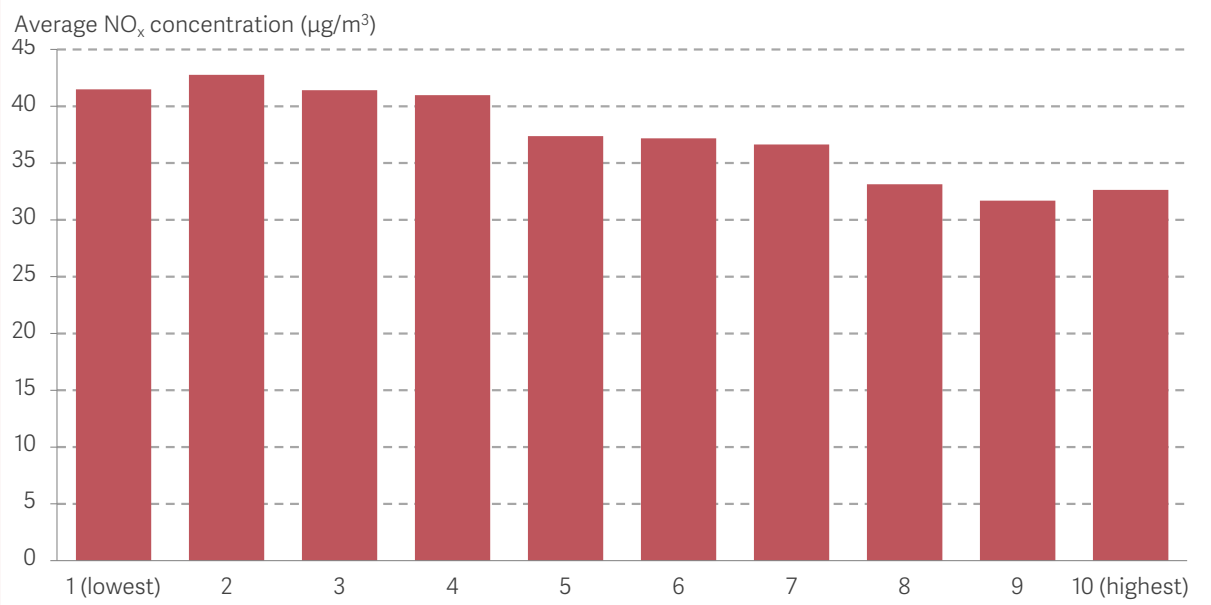
Air pollution is associated with health outcomes that can severely reduce living standards from childhood to death, with increased levels of cardiovascular ill health, childhood asthma and birth defects just a few medical side-effects from breathing dirty air. Children in urban areas are particularly affected: Figure 14 highlights how poorer children are

58 For sources, see: British Vehicle Rental and Leasing Association Outlook, January 2022, and: Used car sales data, SMMT, February 2022.
59 See Department for Transport Energy and Environment data tables. While electric vehicles are heavier than equivalent non-electric models, the recent trend towards larger vehicles also results in elevated levels of particulate matter in the air.
60 Clear the air, British Lung Foundation, October 2021.
61 L Ferguson et al., Systemic inequalities in indoor air pollution exposure in London, UK, University College London, May 2021

more exposed to London's worst air quality, those from the most deprived neighbourhoods attending schools in areas with NOx concentrations 27 per cent higher than schools attended by children from the least deprived areas – an outcome driven by pollution from the capital's roads.[62] The move to net zero will, then, directly tackle air pollution from surface transport.

FIGURE 14: **Poorer children bear the brunt of breathing London's dirty air**

Modelled NO_x concentrations at London primary schools by deprivation levels of areas in which attending children live



NOTES: Income deciles based on the Lower Super Output Area (LSOA) where pupils reside
SOURCE: EDF Europe.

The clear priority is ensuring that the charging network delivers low cost driving to all

As we have seen, there is evidence to be optimistic around the take-up of electric vehicles, which should in turn soon allow low-income households to move to clean transport via the second-hand market.

Once a car has been purchased, the key issue becomes access to charging, enabling households to offset potentially higher upfront costs with significantly lower running costs, compared with petrol and diesel vehicles. For this to occur, however, charger availability (either at home or elsewhere) and the costs of use need to be improved and harmonised. To date, the financial benefits of driving electric cars has been concentrated

62 G Slater, Deprived and BAME schoolchildren in London experience greater air pollution burden, Environmental Defense Fund, February 2021.

in certain groups, such as higher earners, high mileage drivers and multi-car families. While this is needed to seed the charging network, it is not a sustainable long-term solution.

For households with the ability to charge at home this is unlikely to be a major issue, but this parking provision is not spread evenly across society, and there are a large number of issues affecting leaseholders that are yet to be addressed. Those without off-street parking will be forced to lean on the public charging network. Finally, and potentially the most important issue for living standards, households must be able to access fairly priced electricity. This subsection will address these issues in turn.

Household access to off street parking is about to become much more important

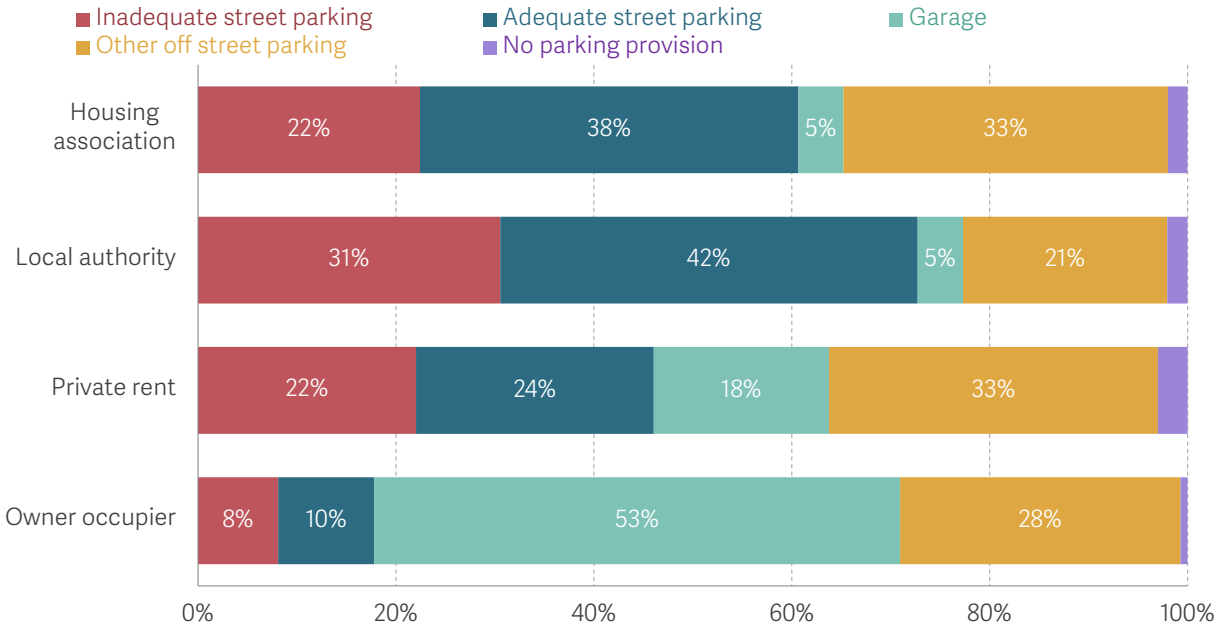
The cheapest and easiest way to refuel an electric car is at home. As such, parking availability is a key barrier to an equitable sharing of benefits. One third of households (9.8 million) across England and Wales do not have access to off street parking, with 76 per cent of the wealthiest families living in homes with a garage or driveway, compared to 56 per cent of the poorest fifth of households.[63]

There are also other important distributional breakdowns. Parking provision differs by housing tenure, with owner occupier households considerably more likely to have access to off-street parking (81 per cent of owner occupiers, compared to just 51 per cent of private renters, see Figure 15). Renters will also face other barriers, as the installation of charging equipment will typically be at the discretion of landlords, who are less incentivised to invest in car chargers than owner occupiers unless the presence of an at-home charger would yield greater rental income.

63 Source: Analysis of English Housing Survey, Welsh Housing Survey.

FIGURE 15: **Owner occupier households are much more likely to be able to charge electric cars at home**

Parking provision by housing tenure: England, 2019



SOURCE: Analysis of English Housing Survey

Some leaseholders could also find it tricky to install at-home charging equipment (of the 4.6 million leasehold properties in the UK, 40 per cent lack some form of off-street parking).[64] The complicated and disparate nature of individual leaseholds present myriad legal questions: who owns the space where the charger will be installed? Are parking spaces private or communal? How should installation costs be spread among leaseholders with different levels of electric car ownership, now and in the future? How will electricity costs be shared? Who is responsible for ongoing maintenance costs? These, and more, will need to be answered to enable widespread charger installation among households owning properties through a leasehold.

All households will make savings by moving to electric cars, but those with off-street parking will be the biggest winners

Cheaper fuel and more efficient engines result in electric vehicles being cheaper to drive than petrol and diesel alternatives.[65] However, it is households who are able to charge at home that will see the greatest savings. Drivers utilising at-home charging could see annual fuel costs fall from around £1,100 for a petrol car to £389, or £139 if low-cost overnight tariffs are used. This significant annual payback – up to £950 – underpins the

64 The Department of Levelling Up, Housing and Communities estimates that there are 4.6 million leasehold homes in England, of which 68 per cent are flats and 32 per cent are houses. Our analysis of English Housing Survey data shows that 24 per cent of leasehold properties have access to garage parking, and 36 per cent to other off-street parking, most commonly a driveway.

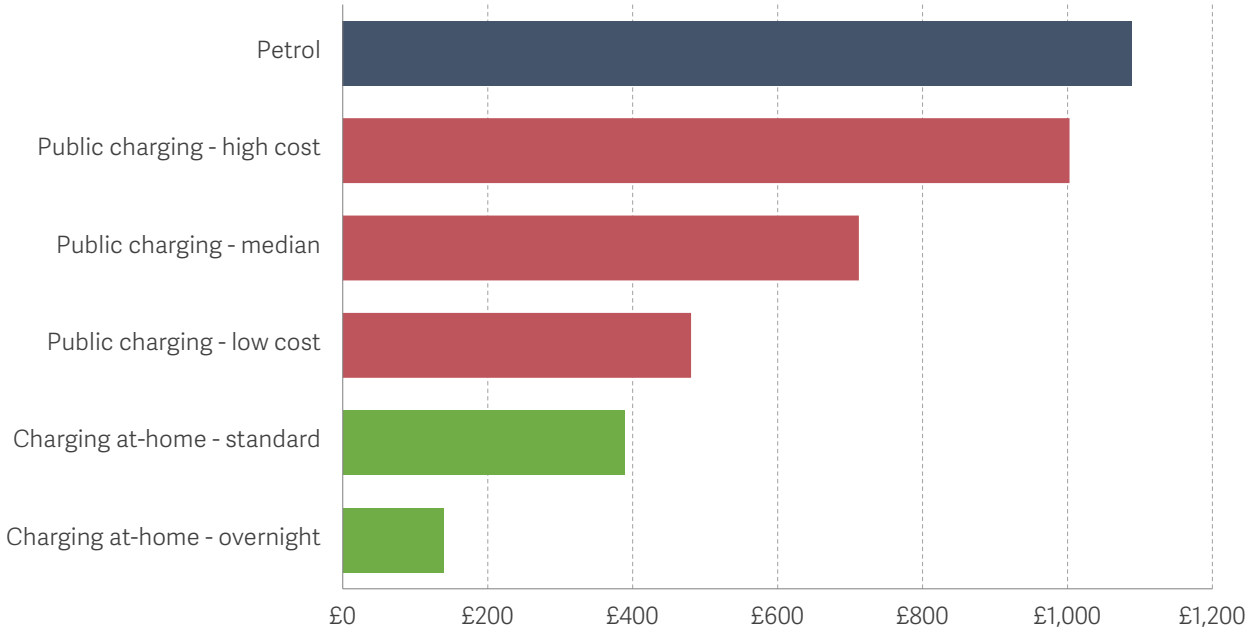
65 Further savings result from lower maintenance costs, with electric motors having fewer moving parts than internal combustion engines, and favourable tax treatment such as an exclusion from Vehicle Excise Duty.

CCC's expectations that lower-priced motoring will be the primary means through which households are repaid for their upfront investment in the net zero transition. On top of these lower running costs, households with access to at-home chargers may also be able to earn money by providing vehicle-to-grid services when their car is parked at home.[66] This is a nascent technology for now, but will become increasingly valuable in balancing the electricity grid as it becomes more reliant on renewable energy, which naturally fluctuates. Typical vehicle-to-grid revenues have been estimated at £100 per household per year, and would be higher still if today's high energy prices persisted.[67] If used alongside cheaper overnight charging, this new technology could see annual motoring costs fall as low as £40, or less than 80 pence per week. These opportunities to drive down costs, however, will not be available to households reliant on public chargers, who will need to disconnect their vehicles once charged to free up infrastructure for others.

Those without at-home charging are reliant on using a public charger, and prices here vary considerably by location, company, charger type and subscription or membership access, resulting in the wide range of annual running costs shown in Figure 16.

FIGURE 16: **Households without off street parking face a wide range of charging prices**

Estimated annual private vehicle fuel costs based on different charging regimes



NOTES: Based on annual private mileage of 7,400 miles per year, in line with DfT estimates (from before private transport use was impacted by Covid-19). Vehicle efficiency of 250 Wh/mile used, comparable to that for numerous lower cost electric cars such as the Fiat 500e, Corsa-e, Hyundai Ioniq electric, Peugeot e-208. 'Low cost' and 'high cost' public chargers are average of the 5 cheapest and 5 most expensive of the 30 most common UK chargers.
SOURCE: Analysis of Department for Transport, Ofgem, Various suppliers' data

66 Vehicle-to-grid technology allows electric car batteries to store electricity at off-peak hours and discharge back into the electricity system with it is most needed, and to provide balancing services such as frequency response.
67 See: Vehicle to Grid Britain, Energy Systems Catapult

The median price across this basket of public chargers results in annual fuel costs of £712, although this can be as low as £480 (or as high as £1,000).[68] This is still cheaper than fossil-fuelled motoring, but it is clear that households without parking provision risk missing out on large annual savings compared with those who can charge at home. Part of this is due to tax rules – VAT is charged at 20 per cent on public charging compared to 5 per cent on home charging, for example – and part due to the fact that the cost of at-home charging is capped by Ofgem's energy price cap, but this is not the case for public chargers. Without addressing this price difference, the ability for all to take part in 'saving later' will be diminished.

A more even distribution of charge points around the country is needed to avoid slowing electric car uptake

In addition to facing higher and varied charging costs, households reliant on public chargers face issues relating to the pace and the uneven geographical distribution of charger rollout. At the end of 2021, there were 29,000 public chargers across the UK, up from 2,200 in 2015,[69] but the CCC has a target of 150,000 public chargers by 2025, nearly doubling again to 280,000 by 2030 (see Figure 17).[70] As such, another priority for the 2020s should be the rapid expansion of the charging system such that it covers all parts of the country and does not impede take-up of electric cars. Existing drivers would also benefit: industry polling of electric car drivers finds that 'increased availability of public charge points' would be the greatest factor in improving their charging experience.[71,72]

68 The median unit cost of electricity across a basket of the UK's 30 largest public charging networks is 38.5 pence per kWh, compared to 21 pence for at home charging, in line with the winter 2021-22 price cap. Overnight charging cost of 7.5 pence per kWh taken from Octopus' Go tariff. Prices correct as of January 2022. Annual mileage assumed to be 7,400, in line with the pre-pandemic national average and vehicle efficiency of 250 Wh/mile used, in line with consumption figures of lower end electric cars, such as the Fiat 500-e, Mini electric, Vauxhall Corsa-e, Hyundai Ioniq Electric and Peugeot e-208. These figures are subject to change as volatile energy markets impact public and at-home charging costs in different ways. Note that the higher cost chargers, as shown in Figure 20 are prime city centre locations, with a significant component of the overall price due to parking charges.

69 Zapmap statistics show.

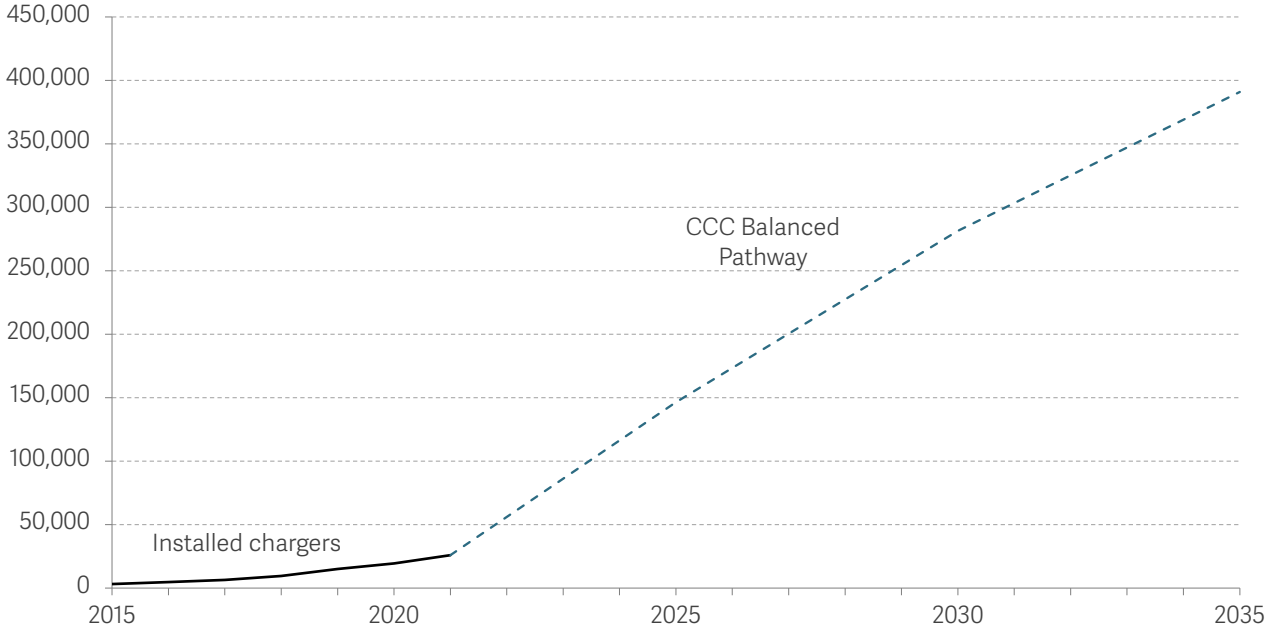
70 2021 Progress report to Parliament, Climate Change Committee, June 2021

71 UK Automotive calls for EV chargepoint mandate governed by independent regulator to level up network for consumers, Society of Motor Manufacturers and Traders, February 2022

72 43 per cent of polled electric car drivers highlighted an increased availability of public charging points, compared to 41 per cent who would prefer faster charging. This is in contrast to other polled European nations, where faster charging was a greater priority. See: EV Driver Survey Report 2021, Shell newmotion.

FIGURE 17: **CCC projections see a rapid increase in the number of public electric car chargers during the 2020s**

Installed public electric vehicle chargers and projections in CCC Balanced Pathway, UK



NOTES: Chart shows the combined number of slow, fast and rapid chargers. Overall progress will largely be driven by fast chargers, with 227,000 of the 2030 total made up of 22 kW and 50 kW devices.
SOURCE: Analysis of CCC data

A common way of measuring the spread of public chargers is to express their number in relation to either the number of plug-in cars or by local population.[73] However, these methods overlook the need for chargers to be in place before a household opts to purchase an electric car, thereby giving the owner certainty that they will be able to charge their car near their home or place of work. As such, it is the ratio of all cars to public chargers that should be considered as this accounts for the number of drivers in an area. Nationwide, this ratio fell nearly 90 per cent from 2015 to 2021 – from more than 11,000:1 to 1,400:1 – as the charging network expanded against a backdrop of a steady number of vehicles on the road.[74]

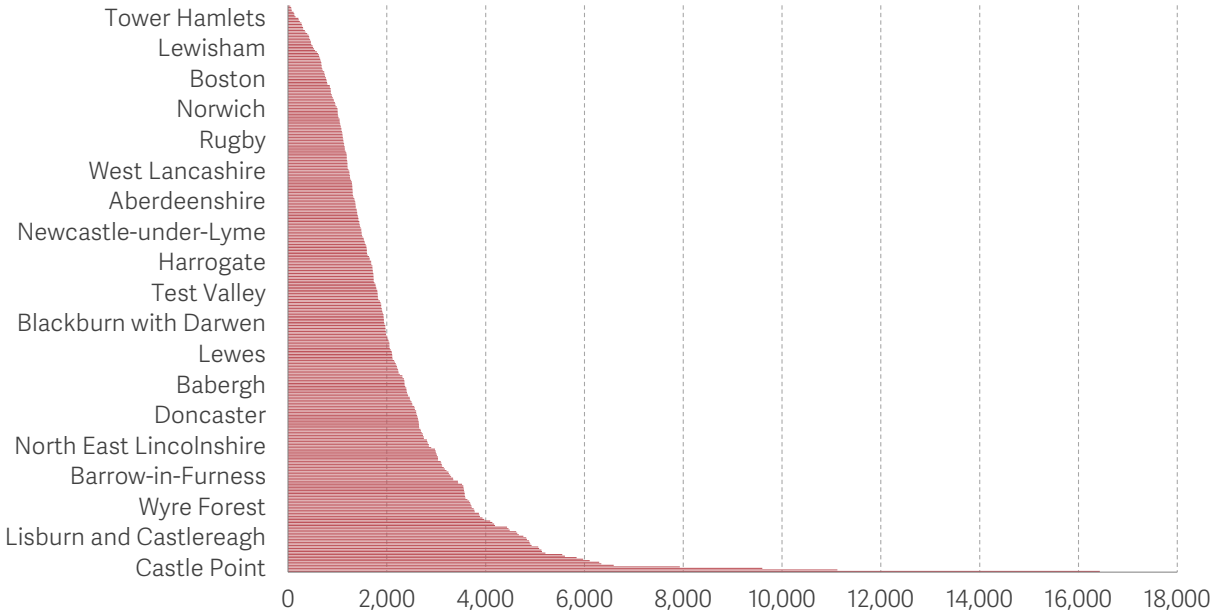
But this masks huge variation across the country, shown in Figure 18. Understandably, private investment in chargers follows demand, and this means that chargers are concentrated in areas with high levels of electric vehicle ownership: they are most available in Westminster, with 44 per registered vehicle. At the other end of the scale, there are no public chargers at all in the Isles of Scilly, and 16,400 cars for each of the 3 public chargers currently installed in Castle Point in Essex. This might be rational behaviour by the private companies building chargers, but in the short-run could lead to

73 See research by SMMT. An alternative is to look at chargers per population, as this report does London School of Economics, although this does not account for variation between areas in the number of who do not drive.
74 At the same time, the ratio of plug-in cars to public chargers increased from 11:1 to 20:1, increasing further to 26:1 over the first three quarters of 2021, data from the Department for Transport shows.

low take-up equilibrium in some areas, where motorists will not switch to electric cars as there aren't sufficient chargers near where they live, and companies will not invest in chargers as there is not sufficient demand. This stand-off risks being a key barrier to widespread electric vehicle ownership in the short-run, and the Government will need to consider whether intervention is needed to ensure a high availability of public chargers, at least until the take-up of EVs has reached critical mass in all parts of the country.

FIGURE 18: **Wide variation in public charger availability results in charging 'blackspots'**

Ratio of total registered vehicles to public chargers by local authority, UK



NOTES: All local authorities shown but only a small number are highlighted on the y-axis for illustrative purposes.
SOURCE: Analysis of Department for Transport data.

This Section has covered the two main aspects of decarbonising surface transport: refreshing the vehicle stock with electric cars, and ensuring that there is fairly priced and sufficient access to charging infrastructure. The next Section of this report brings a shift in focus, moving from a question of investment to aspects of the net zero transition requiring changes in behaviour: flying and food.

Section 4

Limiting demand for flying, meat and dairy

Technological solutions are not going to be able to eliminate greenhouse gas emissions in every sector by 2050, and so a second major challenge is to limit demand for those goods and services that will still contribute to climate change by changing patterns of consumption. Most notably, that includes flying and food, which will account for the majority of households' gross greenhouse gas footprints by 2050.

Although flying has historically become more common over time (with the significant exception of the pandemic), the CCC's path to net zero requires passenger numbers to remain flat between 2019 and 2035 with the path. It does, however, allow for 17 per cent growth in per-person air travel between 2019 and 2050 overall. The Government has been reluctant to reduce demand. For example, it has not yet taken steps to restrict airport expansion or raise taxes on flying. Spending on flying is very unequal: prior to the pandemic, the top 10 per cent of the income distribution were spending more on flying each year than the bottom 50 per cent. So policies to curb demand for flying should be less of a problem for lower-income households' living standards compared to most other sectors. And it is important that the aviation sector does not underperform in terms of emissions reductions, something that would shift the burden of decarbonisation even more onto other sectors.

Changing our diets to reduce their associated greenhouse gas emissions would mean a noticeable change in day-to-day behaviour, and could affect a larger share of household spending. The CCC suggest that a 20 per cent fall in meat and dairy consumption is needed by 2030, and more by 2050. Policy options to achieve this include extending emissions trading to agriculture and food imports, or levying the standard rate of VAT to some food products. But any rise in the price of food would be relatively regressive – absent behavioural change or redistribution – with the bottom half of the income distribution accounting for 43 per cent of meat and dairy spending and the top tenth 12 per cent. So far, the Government has been reluctant to take an active stance on this issue, suggesting that we should not expect major

policy interventions any time soon. But behaviour change is happening anyway: meat consumption fell by 17 per cent over the ten years to 2018-19, and a 20 per cent consumption reduction by 2030 would be in line with longstanding trends for many forms of meat and dairy. This is not to say that the Government should do nothing in this decade – it can at least play its part through public procurement, labelling and reporting, encouraging innovation and competition, and public subsidy reform, for example. But an undesirable outcome would be to raise prices and for consumers not to respond, so the emphasis for now must be on increasing the desirability and normality of lower-impact food options.

Thus far we have focused on two challenges – road transport and home heating – where there needs to be widespread action, but where consumers are not ultimately being asked to change their behaviour significantly. Instead, they are being asked to switch technologies, and to make up-front investments in order to realise savings later.

In some areas of life, however, the public may be expected to actually reduce their consumption of some things. Indeed, around 10 per cent of the emissions savings in the CCC's Balanced Pathway in 2035 comes from changes that reduce demand for carbon-intensive activity.[75] The two most significant forms of consumption here are flying and food, which will account for the majority of households' gross greenhouse gas footprint by 2050. And these two areas were – after carbon capture and storage development – the two biggest gaps in government action identified by the CCC in 2021, which might suggest that new policy changes in both areas will be needed in future – with the potential to directly affect households.[76] We consider both below.

Limiting the number of flights

Demand for flying needs to be constrained

Flying (i.e. domestic and outgoing international flights) accounted for 8 per cent of UK emissions in 2019.[77] Although there are technological opportunities to reduce emissions, there is little prospect of the rapid, wholesale decarbonisation that is expected in some other sectors. As a result, by 2050, flying's share of (gross) emissions will be almost a quarter (24 per cent). This will account for essentially all unabated fossil fuel use by 2050,[78] and will all need to be offset at potentially significant expense.

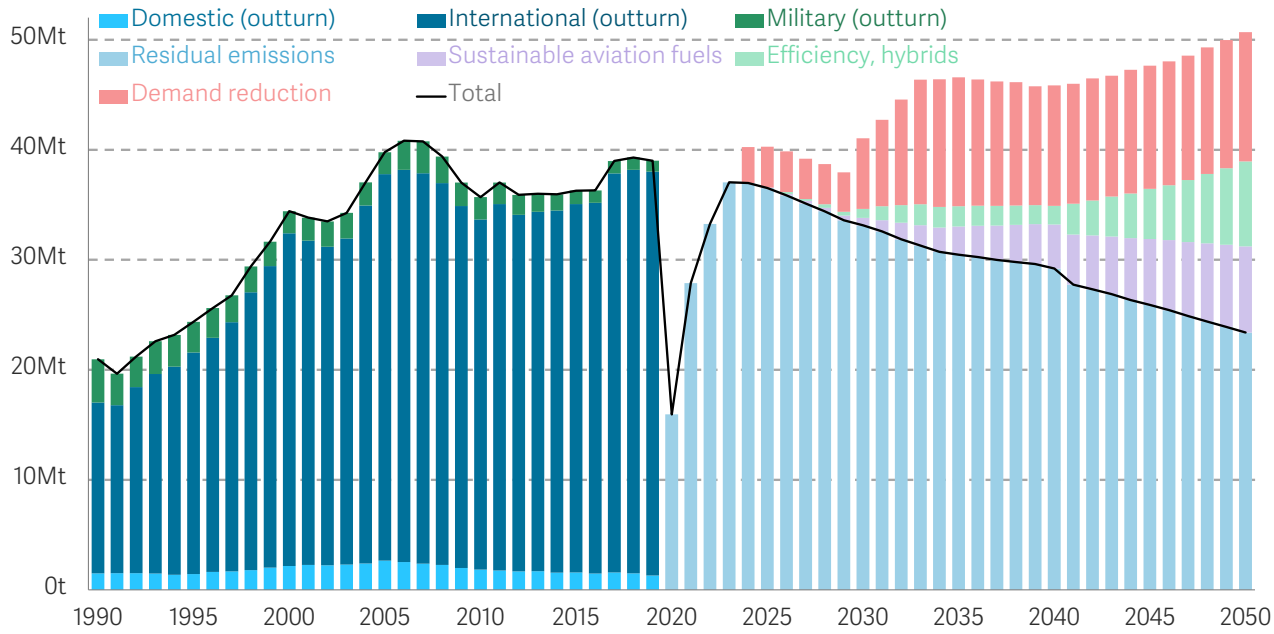
75 CCC, Sixth Carbon Budget, December 2020.
76 CCC, 2021 Progress Report to Parliament, June 2021.
77 CCC, Sixth Carbon Budget, December 2020. This does not include non-CO_2 warming effects, such as from contrails, which may be several times larger than the CO_2 effect. The CCC says that: "the net aviation non-CO_2 effect is to warm the climate. Globally, non-CO_2 effects contribute around two-thirds of the total aviation effective radiative forcing – twice as much as historical CO_2 emissions from aviation."
78 CCC, 2021 Progress Report to Parliament, June 2021.

As Figure 19 shows, aviation emissions rose dramatically up to the financial crisis. And although the pandemic had a remarkable impact, with emissions more than halving in 2020, the CCC has (previously) projected a return to pre-pandemic emissions levels as soon as 2024.

The CCC does not assume that the overall volume of flying needs to be reduced. In its 'balanced pathway', passenger departure volumes still rise from 148 million in 2019 to 183 million in 2050,[79] and per-person travel (by distance) increases by 17 per cent. But this is a significant reduction from 'business as usual' growth, and it requires zero increase in passenger numbers, and some reduction in per-person travel, between 2019 and 2035. As Figure 19 shows, demand reduction (through whatever means) is a key part of the pathway to reduce emissions, contributing 12 $MtCO_2e$ a year by 2050 (with most of that growth averted by 2032).

FIGURE 19: **The Climate Change Committee assumes that aviation emissions will rise over the next three decades unless growth in demand is limited**

Total aviation emissions and sources of abatement, $MtCO_2e$: UK



SOURCE: Climate Change Committee.

Spending on flying is dominated by those with the highest incomes

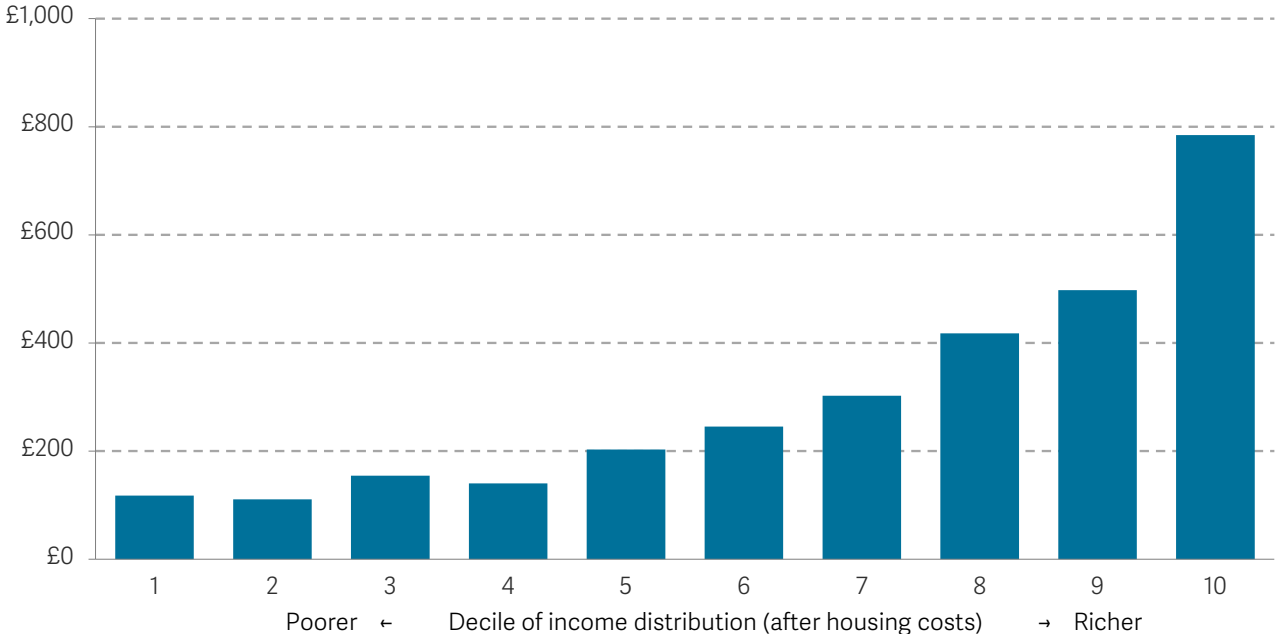
Unlike many areas of spending, such as energy, surface transport, and food (discussed further below), the distribution of aviation spending is spread very unequally across households. Indeed, flying has a greater relationship to a person's total spending than

79 According to assumptions underlying the CCC's Balanced Pathway. Supplied via email correspondence with CCC.

any other major consumption category.[80] Around half of people did not fly in a typical pre-pandemic year, but data from 2014 showed that 15 per cent of people flew three or more times – representing 70 per cent of total flights.[81] Over people's lifetimes, rather than a single year, this inequality might be lower, but we can also see – in Figure 20 – that spending is concentrated among higher-income households. Pre-pandemic, the top 10 per cent of the income distribution were spending more on flying each year than the bottom 50 per cent combined, accounting for 28 and 24 per cent of aviation spending respectively. What's more, this data does not include business trips, which make up 17 per cent of international flights and 38 per cent of domestic flights.[82]

FIGURE 20: **Household spending on flying is very tilted towards those with the highest incomes**

Average annual spending on flights by decile of equivalised household income (after housing costs), 2010 to 2019-20, adjusted to 2020-21 prices: UK



NOTES: The Living Costs and Food Survey is believed to underestimate household spending on flying, relative to the National Accounts.
SOURCE: Analysis of ONS, Living Costs and Food Survey.

The Government has been unwilling to make significant policy interventions to reduce aviation demand, but it should be possible to stay on track without having a large impact on living standards

Although the CCC argues that "Government must recognise the need for demand management as part of a wider strategy to decarbonise aviation",[83] the Government

80 D Ivanova & R Wood, The unequal distribution of household carbon footprints in Europe and its link to sustainability, Global Sustainability, July 2020.
81 Fullfact, Do 15% of people take 70% of flights?, November 2016.
82 UK Civil Aviation Authority, Passenger survey report 2019.
83 CCC, 2021 Progress Report to Parliament, June 2021.

has so far been reluctant to take steps to reduce aviation demand. As we have set out in previous work,[84] flying benefits from favourable tax treatment in the form of zero Fuel Duty and (mostly) zero VAT. Meanwhile, the emissions pricing measure for flights outside the EEA (the Carbon Offsetting and Reduction Scheme for International Aviation – CORSIA) is currently very weak. What's more, Air Passenger Duty for domestic flights has recently been reduced (though flights within the UK and EEA are covered by the UK Emissions Trading Scheme, and so should in time be effectively taxed as carbon prices rise). The Government has also been reluctant to restrict the expansion of airport capacity, and the CCC has urged the Government to consider, in its upcoming 'Jet Zero Strategy', whether the current airport capacity strategy is really consistent with the Climate Change Act.

So there is a good argument that more needs to be done to keep emissions from aviation on track. However, even if the Government does turn to price rises as a way to reduce demand, that need not be a particularly significant concern for most households. The costs of any price rises would be disproportionately borne by those with the highest incomes, so it should be possible to keep a lid on the volume of carbon-intensive flying without significantly impacting the living standards of low-to-middle-income households. The aviation sector does, of course, provide employment, and it is particularly important for the local areas around major airports. But it should be stressed that the CCC's forecasts still envisage passenger volumes increasing: it's just that they need to grow more slowly than they did pre-pandemic and compared with the CCC's 'business as usual' future scenario.

The distributional and often non-essential role of air travel is also reflected in public opinion, with 81 per cent of people saying we should "definitely" or "probably" limit the amount of air travel we do.[85] The pandemic may also offer an opportunity to 'embed' reduced demand, such as for business travel.[86] Moreover, it is also important that the aviation sector does not underperform in terms of emissions reductions. If it did, then the nature of our net zero target would shift the burden of decarbonisation further onto other sectors (or on to carbon capture and storage) – and those who don't fly – and make net zero less equitable. This report does not attempt to set out the exact policy changes that should be enacted to constrain the growth in (non-zero-carbon) flights, but it does appear feasible to meet the required emissions pathway without a major impact on low-to-middle-income households' budgets and lifestyles.

84 G Bangham et al., Unhealthy finances: how to support the economy today and repair the public finances tomorrow, Resolution Foundation, November 2020.
85 See: Institute for Global Change, Planes, Homes and Automobiles: The Role of Behaviour Change in Delivering Net Zero, August 2021. The original data is from: L Whitmarsh, Tracking the effect of Covid-19 on low-carbon behaviours and attitudes to climate change: results from wave 2 of the CAST Covid-19 Survey, CAST Briefing Paper 05.
86 CCC, 2021 Progress Report to Parliament, June 2021.

Limiting meat and dairy consumption

Meat and dairy consumption needs to fall, both to reduce emissions and allow land use changes

In contrast to flying, any change in our diets would be more universally noticeable, more politically contentious, and may bring greater risks (or rewards) for household budgets.

Meat and dairy are the leading drivers of food's significant environmental footprint,[87] with fermentation in animals' stomachs accounting for the majority of agricultural emissions, in the form of methane, a more powerful greenhouse gas than CO_2.[88] For this reason (and the land use issues explored below), in the CCC's balanced pathway, per capita meat consumption needs to fall by 20 per cent of its 2019 levels by 2030, and 35 per cent by 2050, and dairy consumption falls by 20 per cent. In their more optimistic scenarios, consumption of meat and dairy falls by 50 per cent.[89] This is broadly consistent with recommendations in the National Food Strategy, which argued that:

> *"there is currently no way to produce enough food, restore nature and sequester carbon while eating the same amount of meat. To get everything we need from the land, we will have to cut overall meat consumption by 30 per cent."*[90]

As Figure 21 shows, the CCC assumes that we will achieve 10MtCO_2e of annual direct emissions reductions from dietary change (including reducing food waste), similar to the impact of curbing growth in aviation. Overseas emissions resulting from imported food would also fall, but these are not counted.

87 In particular, beef and lamb/mutton are generally assessed to be the highest-emission foods. H Ritchie & M Roser, Environmental Impacts of Food Production, Our World in Data, January 2020. There is a separate, ongoing debate about the global warming impact of at-sea fishing. According to one highly uncertain estimate, bottom trawling in UK waters releases an enormous 19MtCO2e a year from the sea bed (on top of emissions from the boats themselves), and this is not included in UK emissions accounting (source: National Food Strategy: The Evidence, August 2021).

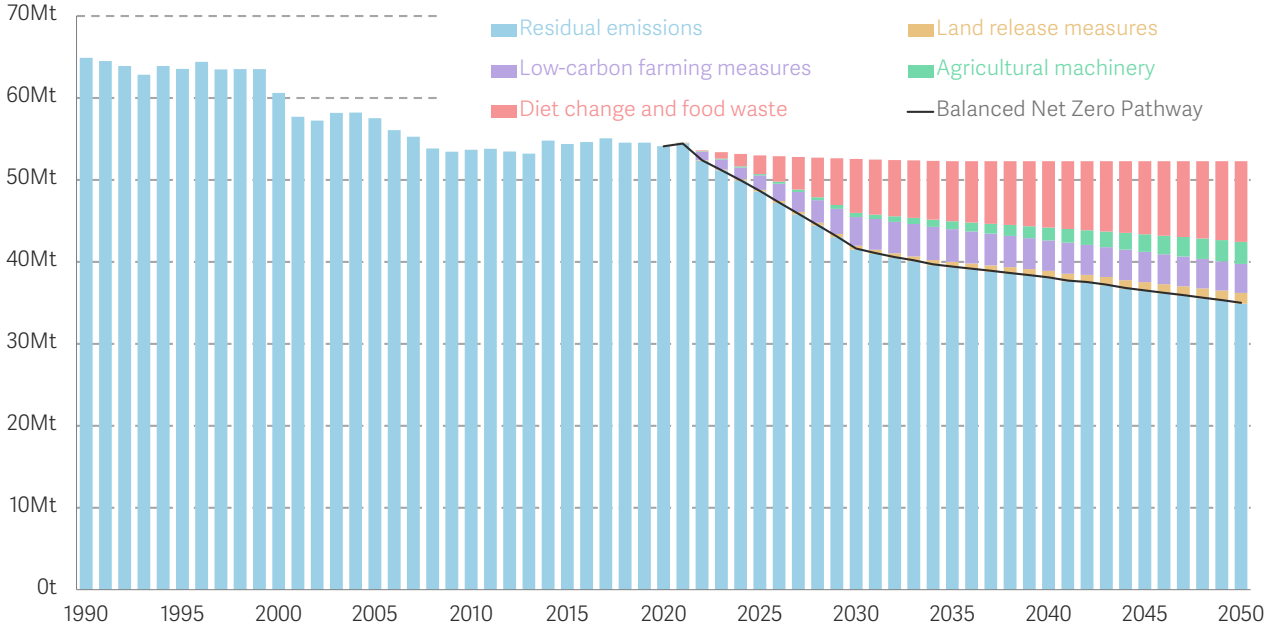
88 There are multiple, debated ways of comparing methane's global warming impact to that of carbon dioxide. In short, the figures given in this section underestimate the potential impact of changes in methane emissions on short to medium-term global temperatures. e.g. BBC News, Climate change: Curbing methane emissions will 'buy us time', August 2021. Methane's higher potency as a greenhouse gas further hastens the need to tackle agricultural emissions.

89 CCC, Sixth Carbon Budget, December 2020.

90 National Food Strategy, August 2021.

FIGURE 21: **Most of the emissions reductions in agriculture up to 2050 are expected to come from dietary change**

Total agriculture emissions and sources of abatement, $MtCO_2e$: UK



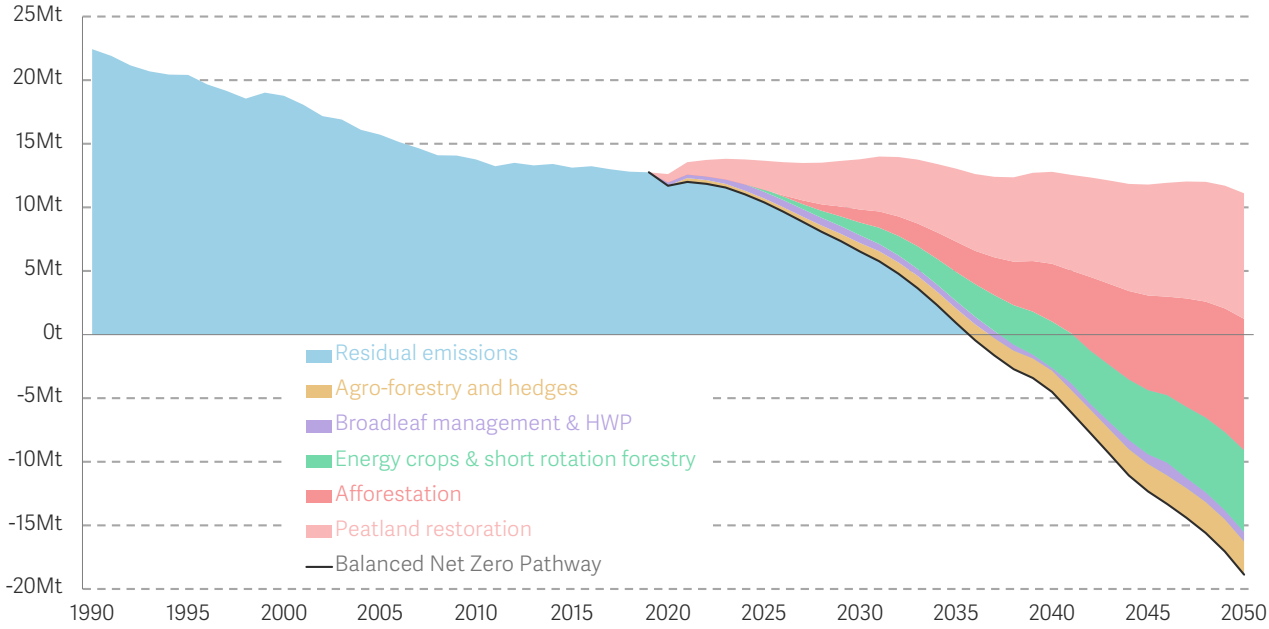
NOTES: Does not include land use changes.
SOURCE: Climate Change Committee.

The role of these consumption changes in the CCC's pathway is not only to reduce emissions directly, however. They are also needed so that – in conjunction with improved efficiency – 9 per cent of agricultural land can be released for climate purposes (including forestry, restored peatland, energy crops and addressing biodiversity loss) by 2035, and almost a quarter by 2050.[91] In absolute terms, that means freeing up 4.4 million hectares of land by 2050 (and 3 million by 2035) – an area bigger than the North of England (3.7 million), Midlands (2.9 million) or Wales (2.1 million).[92] Indeed, the emissions impact of these land use changes is more significant than the direct effects of dietary change, with a reduction of $30MtCO_2e$ per year (see Figure 22), coming on top of reductions in global agricultural emissions that result from land use changes overseas driven by changes in UK consumption).[93]

91 CCC, Sixth Carbon Budget, December 2020.
92 See Figure M.7.7 in CCC, Sixth Carbon Budget, December 2020.
93 The combination of direct and indirect effects of dietary change has been described as a 'double climate dividend': Z Sun et al., Dietary change in high-income nations alone can lead to substantial double climate dividend, Nature Food, January 2022.

FIGURE 22: **A shift from grazing land to restored peatland, forestry and other uses contributes a significant reduction in net emissions**

Total land use, land use change and forestry emissions and sources of abatement, $MtCO_2e$: UK



NOTES: HWP = Harvested wood products
SOURCE: Climate Change Committee.

Overall, net emissions from agriculture and land use did not fall at all over the 2010s, by 2050 they need to have fallen by around $47MtCO_2e$ – more than the entire aviation sector in 2019 ($39MtCO_2e$), or two thirds of residential property emissions (around $70MtCO_2e$).[94] Beyond the ramifications for the farming sector and the landscapes of the UK, this means unavoidable change for consumers. But how will that change come about, and will it have an impact on real incomes and living standards more broadly?

There are tentative signs that change is happening already

There are many policy changes that could be considered to help reduce meat and dairy consumption, but there are some limited signs that change is already afoot – even in the absence of significant policymaking.

Looking first at the most recent levels, the data set out in Figure 23 shows that 29 per cent of people say they "avoid / eat less meat". In YouGov survey data, a similar proportion describe their diets as vegan, vegetarian, pescatarian or (most commonly) flexitarian (i.e. "mainly vegetarian").[95] Women are notably more likely than men to say they limit their

94 See: BEIS, Final UK greenhouse gas emissions national statistics: 1990 to 2019, February 2021.
95 YouGov tracker, Dietary choices of Brits. In the separate Food and You survey (Food Standards Agency, January 2022), there are similar results in most categories but fewer people describe themselves as 'mainly vegetarian' (in that data) than describe themselves as 'flexitarian' (in the YouGov data).

meat or dairy consumption, but the clearest predictor is people's degree of concern about climate change. And – on a more theoretical level – 70 per cent of people agree that we should "definitely" or "probably" reduce the amount of meat in our diets.[96]

FIGURE 23: **More than one in four people already limit their meat consumption**

"Thinking now about your everyday life, do you do any of these things?", March 2021: UK

SOURCE: BEIS Public Attitudes Tracker - Wave 37 (March 2021).

Although consumption data is not very timely, there is also evidence suggesting that the recent trend is in the right direction. Academic work has shown that average meat consumption declined by 17 per cent between 2008-09 and 2018-19.[97]

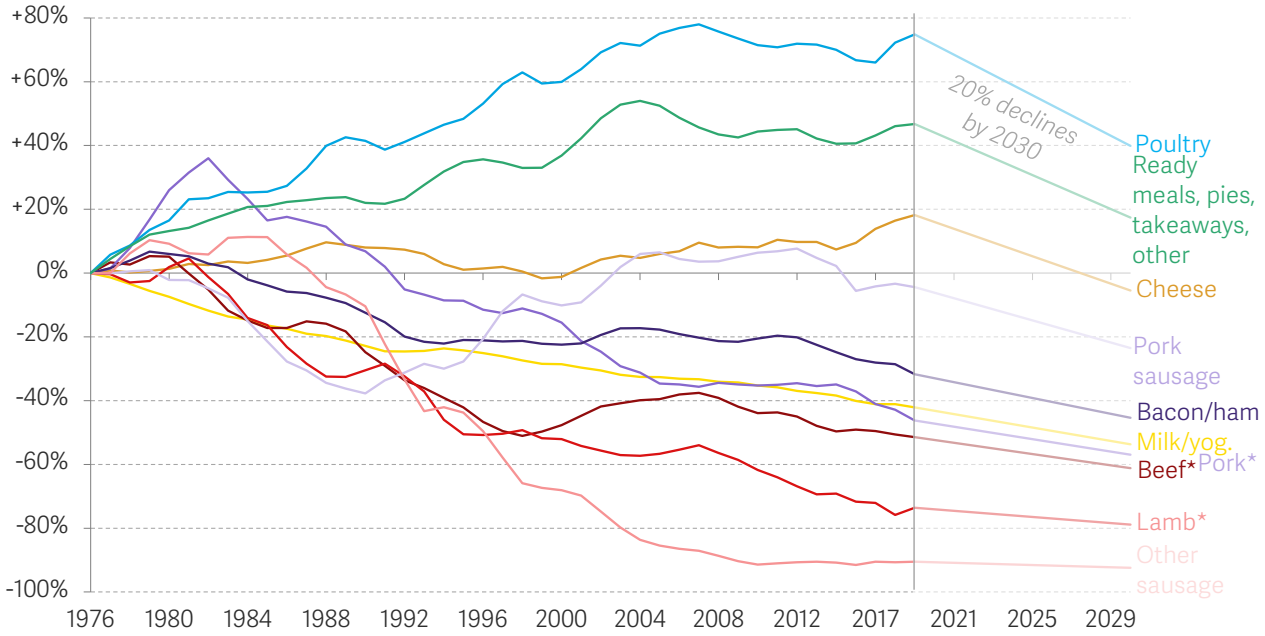
Looking at longer-term data, as we do in Figure 24, shows that there are very significant differences between categories of meat and dairy, however. Consumption of unprocessed lamb and mutton per person fell by three quarters between the mid-1970s and 2019-20. Milk consumption per person fell by around a tenth over the decade up to 2019-20, and unprocessed beef consumption by a fifth, both continuing long-term trends. But consumption of poultry and meat-based ready meals is far higher than in the 1970s and 1980s, and cheese consumption has been rising.

96 See: Institute for Global Change, Planes, Homes and Automobiles: The Role of Behaviour Change in Delivering Net Zero, August 2021. The original data is from: L Whitmarsh, Tracking the effect of Covid-19 on low-carbon behaviours and attitudes to climate change: results from wave 2 of the CAST Covid-19 Survey. CAST Briefing Paper 05.

97 C Stewart et al., Trends in UK meat consumption: analysis of data from years 1–11 (2008–09 to 2018–19) of the National Diet and Nutrition Survey rolling programme, The Lancet, October 2021.

FIGURE 24: **For some meat and dairy products, a 20 per cent fall in consumption over the 2020s would be merely a continuation of previous trends**

Change in three-year average household consumption per person of meat and milk products since 1976: UK



NOTES: * Pork, Beef/ veal and Lamb/ mutton refer to 'carcase meat' only. Figures based on weight (or volume for milk and yogurt). Projection based on a 20 per cent reduction in per-person levels by 2030 relative to the three years from 2017-18 to 2019-20. Does not include food consumed outside the home, but that is smaller in scale.
SOURCE: RF analysis of Defra, Family Food Survey, 2019-20.

These figures help to put into context the CCC's pathway of a 20 per cent fall over the 2020s: for some products, such a fall would be a continuation of the existing trend (or less), but for others it requires a change in direction. The latter includes the broad category of ready meals, pies and similar, but these are the products are perhaps the easiest areas for customers to make substitutions (e.g. plant-based burgers instead of beef burgers) and for manufacturers and retailers to reformulate their products to reduce their emissions impacts.[98]

Figure 24 does show that dietary change over the past decade may have slowed in some areas, but there are other reasons to be optimistic about the CCC's goal. For example, there has already been an explosion in the range of meat and dairy alternatives available. Leading supermarkets have committed to halving their climate impact by 2030.[99] And there is evidently potential for additional food production innovation such as precision fermentation-based dairy, better plant-based meat substitutes, and cultured meat.

98 National Food Strategy, August 2021.
99 BBC News, COP26: Supermarkets promise to halve environmental impact by 2030, November 2021.

There are policy options that would use higher prices to help lower demand, but these would be relatively regressive

The fact that change may be happening organically is welcome, as one alternative – if agricultural and land use emissions don't begin to fall rapidly – may be for the state to take steps to increase the price of high-emission foods.[100]

One route for achieving this would be to include agricultural emissions in the Emissions Trading Scheme or other carbon pricing. In New Zealand (where agriculture is an even larger share of emissions) the intention is for agricultural emissions – including in the form of methane – to be reported and priced at a farm level by 2025, though exactly how this will operate is still being debated.[101]

In the absence of emissions pricing, there is also the possibility of a more straightforward tax rise for meat. This might also reflect other policy considerations (many of which are beyond the focus of this report). In particular, there are links between red meat (and especially processed red meat) consumption, cardiovascular disease mortality, diabetes and strokes;[102] considerations around river and air pollution;[103] animal welfare concerns; and biodiversity impacts. The National Food Strategy concluded that:

> *"The social costs from climate change and nutrient pollution for beef add up to between 35–56 percent of average retail prices in high-income countries. Additionally, accounting for biodiversity loss and diet-related health impacts would increase this number substantially. [...] Including the valuation of privately incurred health effects would approximately triple the appropriate tax on unprocessed beef".*[104]

As an illustration, applying the standard VAT rate of 20 per cent to meat products (rather than zero) would raise up to £6 billion a year.[105] Applying the lower 5 per cent rate that currently applies to energy could raise over £1 billion, and cost the average household around £50 a year (assuming the tax rise was fully passed on to consumers), although these figures simplistically assume no behavioural changes, which of course would be the point of the tax rise.

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100 There is evidence that meat consumption is relatively responsive to prices (see: T Andreyeva, M Long & K Brownell, The impact of food prices on consumption: a systematic review of research on the price elasticity of demand for food, American Journal of Public Health, 2010) and arguably that responsiveness should increase as the availability of meat alternatives increases.

101 See: Ministry for Primary Industries, Climate Change and the Primary Industries, November 2021; ICAP, New Zealand reaches agreement with agricultural sector to price emissions from 2025; and RNZ, 'Corporate welfare': Push back over proposals that would reduce emissions by 1pc, 25 November 2021.

102 See: W Willett et al., Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems, The Lancet Commissions. February 2019.

103 House of Commons Environmental Audit Committee, Water Quality in Rivers, January 2022.

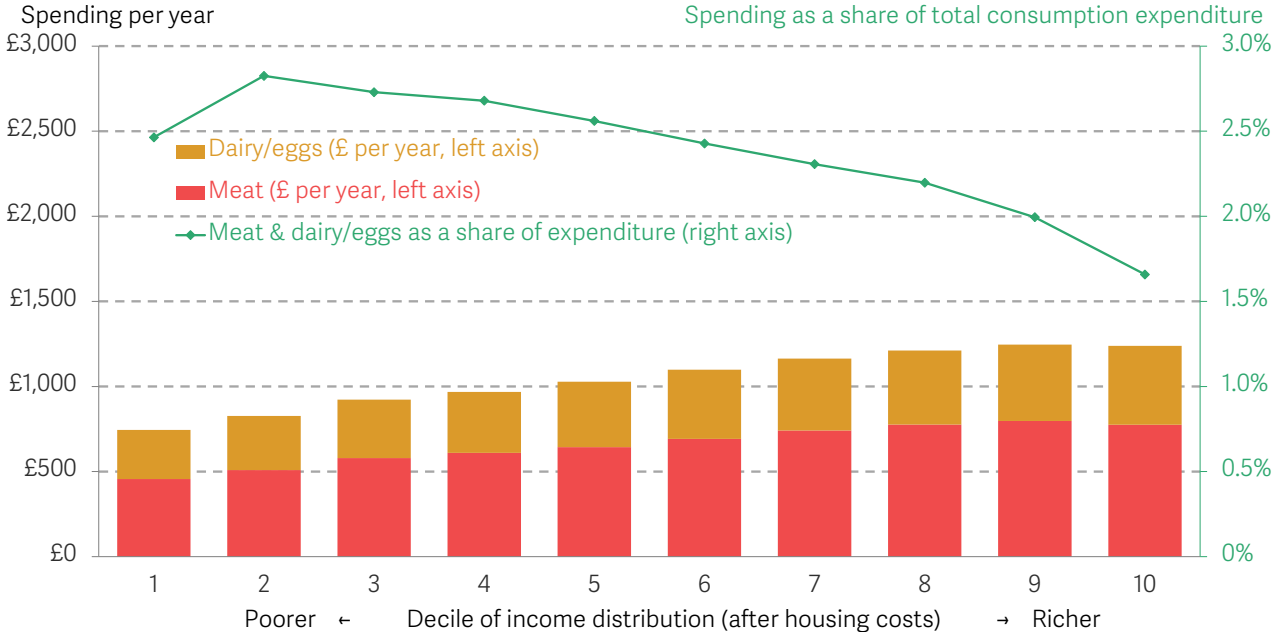
104 F Funke et al., Is Meat Too Cheap? Towards Optimal Meat Taxation, Review of Environmental Economics and Policy, January 2022.

105 Analysis using ONS, Family Spending, 2019-20. This assumes no behavioural impacts and so is likely an overestimate, though prices have risen since 2019-20. A similar charge on milk, cheese, eggs, butter and other milk products would raise up to £4 billion a year, while VAT on seafood would raise up to £2 billion.

However, it is clear that increasing the price of some foods would be a relatively regressive cost of living increase – in stark contrast to aviation taxes. That said, it would be important to consider how any potential revenue would be used – i.e. would it be redistributed to lower-income households, or use to fund carbon capture processes to offset the greenhouse gas emissions – and also what the health impacts might be.[106] But the distributional consequences (absent behaviour change) or any recycling of revenues is shown in Figure 25: it shows that households spend significant amounts on meat and dairy, averaging around £1,000 a year (far more than is typically spent on flights as shown in Figure 22). And it is much more evenly spread across the distribution, with the bottom half of the income distribution accounting for 43 per cent of meat and dairy spending, while the top tenth account for 12 per cent.

FIGURE **25**: **Spending on meat and dairy is relatively flat across the income distribution, but does tend to increase with income**

Average annual spending on meat and dairy by decile of equivalised household income (after housing costs), 2010 to 2019-20, adjusted to 2020-21 prices: UK



SOURCE: Analysis of Living Costs and Food Survey.

In contrast to aviation, the significance of food prices to day-to-day living standards is reflected in public opinion. The Climate Change Citizens Assembly found that there was (after discussion) support for reducing meat consumption, but there was far less support for tax rises.[107] In one survey, while 32 per cent supported "New taxes on meat, like beef, that produces a lot of carbon emissions", 55 per cent were opposed.[108] Politicians may

106 F Funke et al., Is Meat Too Cheap? Towards Optimal Meat Taxation, Review of Environmental Economics and Policy, January 2022.
107 Climate Assembly UK, The path to net zero, September 2020.
108 See: Institute for Global Change, Planes, Homes and Automobiles: The Role of Behaviour Change in Delivering Net Zero, August 2021. The original data is in: YouGov/Sky Survey, March 2021.

well fear that a 'meat tax' would not only be unpopular but even damage perceptions of the broader net zero goal at a time when significant public 'buy-in' is required on transforming heating and road transport.

There are also some practical objections to measures such as extending carbon pricing to farming in the medium-term. For example, there is the question of designing and implementing a workable and fair system for estimating (gross or net) emissions at the level of individual farms, as well as for food imports. This is complicated by the fact that the UK's Emissions Trading Scheme is in its infancy and needs to be developed. Another practical issue arises because the agricultural sector is already grappling with a complete overhaul of subsidies (with basic 'Direct Payments' being phased out in England over the period from 2021 to 2027) and significant changes in international trade rules and competition – including through the trade deal with Australia. Very recently, the meat sector has also been hit by recruitment problems, CO_2 shortages, avian flu and swine flu. Some of these changes may themselves lead to reduced production and/or consumption of meat.

Given tentative progress and distributional concerns, encouraging alternatives should be a higher priority than raising prices

Perhaps reflecting some of these concerns and public opinion, the Government has been reluctant to take an active stance on reducing meat and dairy consumption – suggesting that we should not expect major policy interventions any time soon.

The tentative signs of declining meat consumption and changing norms, however, mean that this is not necessarily cause for concern in terms of climate change. The ideal would of course be for enough consumers to voluntarily shift towards lower-impact, healthier, and potentially cheaper diets.

That is certainly not to say that the Government should do nothing, however. In particular, the Government can directly change public sector food provision (at least in line with the Climate Change Committee trajectory). It can also mandate – or at least facilitate – the assessment of food products' emissions, for labelling and corporate reporting;[109] continue to reform agricultural and land-use subsidies; and encourage Britain's 'alternative protein' sector (at present, such start-ups are particularly concentrated in the U.S. and Israel, rather than the UK).[110] Indeed, while the sensitivity of family budgets to meat and dairy prices is a reason to be cautious about imposing price rises, it is also a reason to encourage cheaper alternatives and competition from new products, something that could boost real incomes rather than reducing them.

109 K Taufique et al., Revisiting the promise of carbon labelling, Nature Climate Change, January 2022.
110 Institute for Global Change, The Protein Problem: How Scaling Alternative Proteins Can Help People and Planet, November 2021.

So, although we should keep an open mind about policies such as agricultural emissions pricing for the future – and policy makers should watch the efforts in New Zealand closely – the emphasis for now must be on increasing the desirability and normality of lower-impact food options.

In this section, we have argued that both aviation and agriculture and land use are important parts of the net zero transition, it seems likely that the overall scale of disruption to people's budgets and everyday lives in the 2020s is likely to be less significant than the changes to homes and cars explored earlier. At an individual level, overhauling one's home heating or switching to an electric vehicle will be an obvious and discrete change, but changing our diets might be a gradual and flexible process. As the CCC says of food and flying:

> *"We note that in each of these areas there is a possibility of progress even with little policy action, given the strong public desire to act on climate change and the possible lasting impacts of the pandemic. However, Government leadership, public engagement and wider policy can help accelerate these shifts."*[111]

111 CCC, Independent Assessment: The UK's Net Zero Strategy, October 2021.

Section 5

Conclusion

This report has assessed how households will be impacted by the net zero transition in the decade ahead, focussing on how decarbonisation will impact consumption in home heating, surface transport, food, and flying. Decarbonising these sectors will impact on virtually every household in the country, but will do so in different ways.

Home heating and surface transport will, as with many other challenges that the 2020s will bring, require significant private and public upfront investment. This will be centred on electric cars, heat pumps, insulation and charging infrastructure. Once these are in place, however, savings from lower energy bills and cheaper motoring will be available. For flying and food, the challenge is one of changing behaviour, with reduced consumption key to bringing down households' carbon footprints. The growth in demand for flying, an activity overwhelmingly participated in by the wealthiest households, will have to be curbed. And the consumption of red meat and dairy products will need to fall significantly during the 2020s to prevent the associated costs from these sectors falling to others in society.

When considering home heating and surface transport, we argue in this paper that it is the 'complementary investments' in home insulation and the charging infrastructure, rather than in heat pumps and electric cars, that needs to be the policy priority in this decade. Home insulation will yield lower energy bills in the short term, and also facilitate the more efficient running of heat pumps once roll-out begins at pace in the 2030s. Public charging capacity for EVs will need to both be increased in coverage but also controlled in a way that means that the cost savings from EVs are available to all households. Policy makers will need to be attuned to the risks facing households unable to charge at home and those, particularly low-income homeowners, who may find it difficult to insulate their homes.

Decarbonising flying and food are likely to present less of a challenge to household budgets in comparison. The distance each person flies each year is still assumed to be

higher in 2050 than pre-pandemic, and the top-heavy nature of aviation spending means that any impacts of policy on prices will be disproportionately borne by those most able to cope. Meanwhile, there are grounds for optimism that diets are changing and so food policy – though still needed – will not need to fight an uphill battle.

How best the Government should deliver on these decarbonisation challenges, alongside responding to the challenges of being outside the EU and the aftermath of Covid-19, will be the subject of future Economy 2030 Inquiry reports.

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2. Levelling up and down Britain: How the labour market recovery varies across the country
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For more information on this report, contact:

Jonathan Marshall
Senior Economist
jonathan.marshall@resolutionfoundation.org

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