THE ECONOMY 2030 INQUIRY

SHAPING A DECADE OF CHANGE

The Carbon Crunch

The launch report for The Economy 2030 Inquiry

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Centre for Economic Performance

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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.

The Nuffield Foundation

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Summary

The UK is entering a new phase in its journey to net zero. Since 1990, the UK has cut territorial carbon emissions by close to 50 per cent, but we are far from half way towards ending our contribution to climate change: eliminating the remaining half – by cutting carbon from our homes and transport – will be more disruptive than the first – when we mainly cut carbon emissions from electricity generation.

The next decade is crucial and needs to combine a 'double acceleration' of the UK's transition to a low carbon economy in which the pace and depth of emission reduction increases at the same time as ensuring new policies do not widen inequalities by loading costs onto lower income households or allowing the benefits to flow to the better off.

This approach needs to be set out soon. Net zero will be a key driver of economic change in the 2020s and beyond, leading to changing patterns of consumption and large-scale investment with significant impacts on government, firms, workers and consumers. It also fundamentally changes the context for the UK's economic strategy, which is in desperate need of renewal as we seek to drive a strong, sustainable and inclusive recovery from Covid-19 and adjust to changes in international relationships and domestic policy post-Brexit.

The UK enters this key period with a number of advantages; its position as host of COP26 and as a reputation as a global climate leader; an impressive record on cutting emissions in recent years; an institutional framework resulting from the 2008 Climate Change Act, notably the creation of the Climate Change Committee (CCC); and widespread support for decarbonisation across the political spectrum and society, with 80 per cent of the public concerned about climate change, the highest figure on record. These advantages will need to be leveraged during the next phase of net zero, which will involve more societal and behavioural change than that seen in recent decades.

For example, emissions from surface transport are virtually unchanged from 2010, and those from residential buildings have actually increased. From now to 2035, transport emissions will need to fall by more than 72 per cent, while emissions from our homes will need to fall by almost half (48 per cent). This will involve change – good and bad – from households, both as consumers and as workers.

Much of the debate among proponents for urgent climate action has been centred on the ambition of targets or on which technological solutions are most appropriate. At the same time, those resisting change focus on aggregate costs as a reason for delay. The debate must now move on to how best the delivery of net zero can be integrated into mainstream economic policy making, ensuring that the transition is as smooth as can be and capturing as many co-benefits, such as cleaner air and warmer homes, as possible.

We also need to begin long-overdue discussions with the British public: in the next three decades, changes in production and consumption will have significant impacts on the daily lives of citizens across the UK, from cars and charging points, to insulation and heating systems.

Starting these discussions is the focus of this paper, which highlights the challenges and opportunities that need to be overcome or seized if the UK is to make a success of the 2020s:

- Wrestling with **change**: through the 2020s, accelerated decarbonisation will be a major driver of economic change that is visible to the public as workers and consumers. Decarbonising our homes and surface transport, as well as in areas such as diet, aviation and industry, will be much more difficult and disruptive than decarbonising electricity generation. An estimated 59 per cent of remaining decarbonisation out to 2035 requires some form of societal or behaviour change, compared to just 13 per cent of that seen in the 2009-2019 period. And this changing nature of decarbonisation, and urgency at which it is needed, will cause disruption – good and bad – across the country. Understanding and managing this change is a central feature of a successful net zero transition, that reduces the risk of net zero negatively affecting living standards or damaging parts of the country dependent on high-carbon sectors. The Government will also need to decide how best to support new technologies and industries, but these policies will involve trade-offs about the nature of change. Should we accept, for example, higher energy or technology costs in order to bring high-value industries onshore, or instead to take the benefits of cheaper energy to established industry?
- Managing **costs** fairly: the net costs of decarbonisation, currently pegged at around £300 billion over the next three decades, are manageable, at under 1 per cent of GDP through to 2050. However, this aggregate figure hides risks associated with timing, where investment costs predate savings by years, or even decades. In particular, the CCC's Balanced Pathway to net zero requires annual net investment of £27 billion per year over the decade ahead (2021-30), £15.9 billion per year in the 2030s, before an average annual net payback of £11.2 billion in the 2040s. There is also a risk that the burdens and benefits from net zero are not shared fairly. For example, decarbonising our homes is forecast to cost property owners over £42 billion over the decade ahead, but low-income households are increasing found living in the most energy-inefficient houses, whereas a decade ago it was higher income households whose homes were least efficient. This is concerning in light of the fact that government support for energy efficiency has been targeted largely at households in fuel poverty in recent years. And in surface transport, the source

of most of the savings from moving to net zero, there is a clear slant across the income distribution in who owns a car and who has the space to install lower-cost at-home charging: 76 per cent of households in the top income quintile have off-road parking, compared to 56 per cent in the bottom quintile; close to half (45 per cent) of low-income households don't own a vehicle at all. The eventual distributional impact of the costs of moving to net zero is almost entirely dependent on government policy; identifying, understanding, and accounting for these issues is crucial to a smooth navigation of the transition.

- Updating our economic strategy to reflect the fundamental changes in **context**: net zero commitments in the UK and internationally mark a fundamental change to the backdrop within which nations shape their economic strategies. This poses challenges but also gives rise to new opportunities, including an investment and innovation-led "green recovery". Central to this will be the invention and diffusion of net zero technologies – such as in ocean and wind technologies, where the UK has a "revealed technological advantage" and economic returns to investments in R&D in the UK are high – and investments in complementary, productive assets across infrastructure, human, natural and social capital. Net zero also changes the fiscal context, eroding long-standing sources of tax revenues and advancing debates regarding the efficacy of carbon pricing. Given the unprecedented and global nature of the climate challenge, and the need to act quickly, we will need creative, directional and participatory approaches to policy making to ensure a system-wide view, build crucial understanding, and get buy-in from citizens and consumers.

The zero-carbon transition will affect everyone, but some more than others. By taking the reins of a direct driver of economic change in the decades ahead, a government that actively manages the transition to net zero can ensure that the costs do not land on the shoulders of those least able to bear them.

This launch report forms part of Phase one of the Economy 2030 Inquiry, a joint project between the Resolution Foundation and the London School of Economics. In presenting the case for focusing on these concrete economic policy questions, it sets out the agenda for the Inquiry's work on net zero over the coming two years. It will be followed by specific papers on how net zero will affect households, on the implications for jobs and places, and how the UK can best identify growth opportunities in the transition to net zero. It will run alongside other research themes, such as the recovery from Covid-19, Brexit, and changing demographics, ultimately helping to inform the policies and recommendations made in the Inquiry.

Introduction

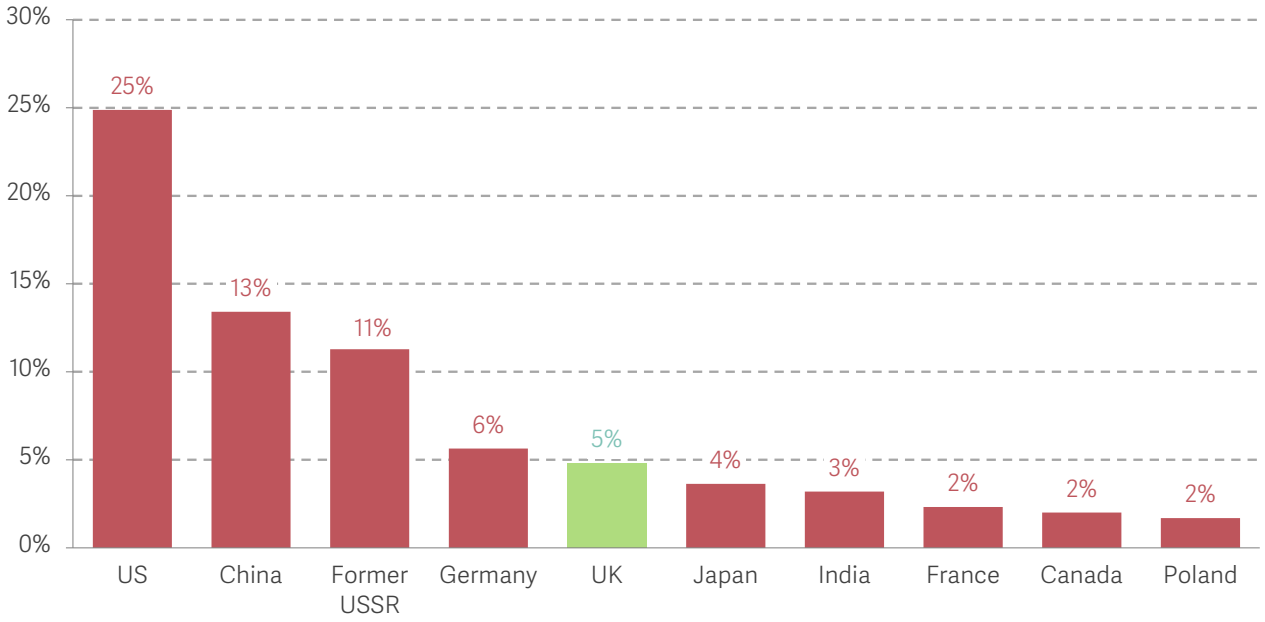
There are clear moral, legal and economic cases for UK taking swift action on climate change

Global temperatures have already increased by 1°C compared to pre-industrial times, with efforts this decade critical in limiting the rise to 1.5°C – the target agreed in the 2015 Paris Agreement.[1] Current climate commitments mean we are not on track to meet this target, and, as the host of COP26 in winter 2021, the UK plays a pivotal role in renewing efforts to meet this global goal.[2]

This role is reinforced by our history. As the pioneer of industrial (and polluting) production methods that have been exported around the world, the UK has a historic contribution to climate change that is far greater than its current level of emissions: overall, the UK is the fifth-largest contributor to anthropogenic carbon emissions (see Figure 1). As such, the UK has a clear moral obligation to act on climate.

FIGURE 1: **The UK has an outsized historical contribution to climate change**

Share of cumulative anthropogenic CO_2 emissions: 1750-2019



SOURCE: Analysis of Global Carbon Budget data.

This case helps explain why past governments have acted on climate. The 2019 amendment to the 2008 Climate Change Act obligates successive governments to end the UK's contribution to climate change by 2050. The Act also requires the UK to meet a series of interim Carbon Budgets, each covering five-year periods out to delivering net

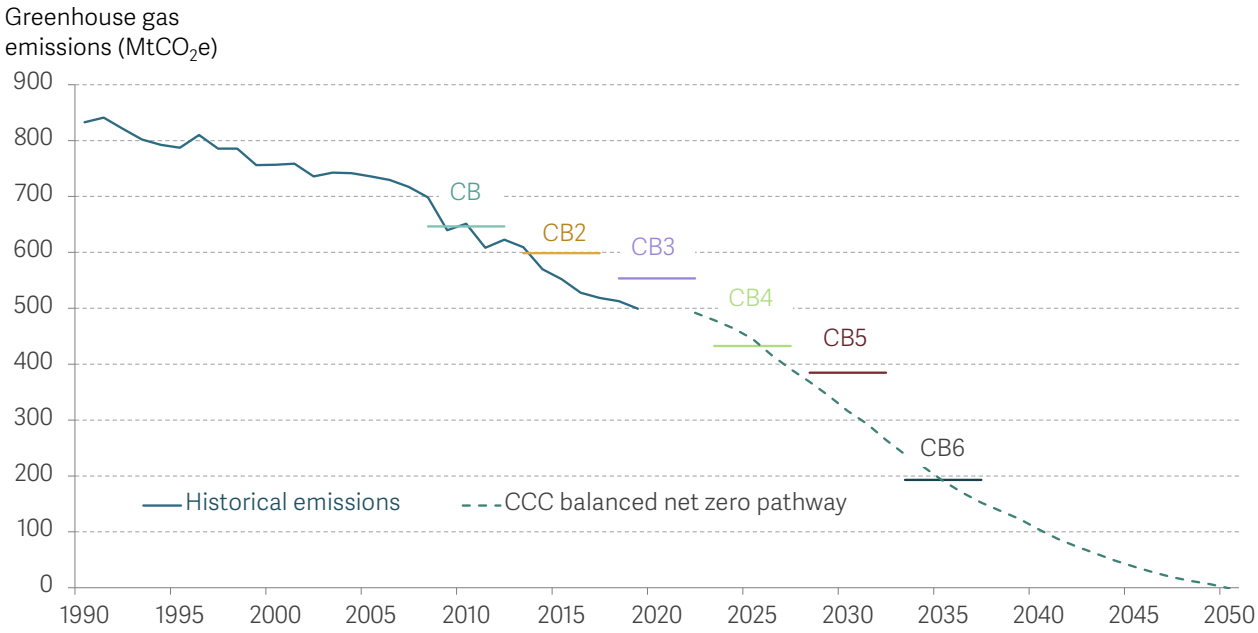
1 IPCC, Sixth Assessment Report, August 2021. The IPCC refers to 'pre-industrial times' as 1850-1900.
2 UNFCCC, NDC Synthesis Report, September 2021.

zero emissions by mid-century (see Figure 2). The UK has met, or is on track to meet, the first three budgets, running from 2008-22, but on current policies it will miss the three subsequent budgets.[3]

In addition to these domestic commitments, the UK has an additional target for 2030 that increases ambition within this decade. Set as part of the UN Framework Convention on Climate Change (UNFCCC) process, the UK's Nationally Determined Contribution (NDC) requires a 68 per cent cut on 1990 emissions by 2030, upping the ante on national targets for the same year.[4]

FIGURE 2: **Future carbon budgets will need more widespread decarbonisation**

Historical territorial greenhouse gas emissions, future carbon budgets and the CCC's recommended pathway to 2050



NOTES: Carbon Budgets 1-5 shown inclusive of headroom for international aviation and shipping emissions. 2020 emissions omitted to avoid distortions resulting from Covid-19.
SOURCE: Analysis of CCC, BEIS data.

There are also clear economic benefits from acting early. First, delay implies higher costs. The UK's Carbon Budgets are set as the most cost-effective path to the 2050 target. This includes a steady rate of decarbonisation, balancing the risks that come with waiting for technology costs to fall and those associated with overdelivering and reaching net zero early. Deviating from this smooth emissions reduction curve will lead to more disruptive and more expensive actions. The Office for Budget Responsibility (OBR) has also stressed the importance to the taxpayer of acting in line with CCC guidance, warning that both overall costs and those falling to the public purse would be much higher if action was

3 Green Alliance, Net Zero Policy Tracker, September 2021.
4 The Fifth Carbon Budget, covering 2028-32, requires a 57 per cent reduction on 1990 emissions levels.

delayed until 2030 and sharper emissions cuts were needed.[5] An economic model for the UK based on steady decarbonisation will reduce the risk of value destruction, asset stranding and general disruption that would result in more drastic action later, all of which would impart higher overall costs onto the transition.

Second, quick and decisive action increases the likelihood that potential growth opportunities are captured in the UK. In the long run, low-carbon growth is the only feasible type: given the immense damage to lives and livelihoods predicted in a world where temperatures stabilise above 1.5°C above the pre-industrial level, it is clear that a high-carbon path would be unsustainable, if not outright self-destructive.[6] As an advanced economy, operating at the global innovation frontier in many areas, there are strong economic arguments for the UK to act early, with the appropriate supply- and demand-side policies that can help to secure first-mover advantages in high-growth "clean" sectors, developing the UK's comparative advantage in technologies, products and services for which demand will surge over the coming decade and beyond.[7] And the UK already has relative strengths in a number of clean sectors, such as green finance and renewable energy, as well a relatively low number of workers employed in high carbon jobs – compared to Germany or the US, for example – due to previous structural economic changes. There are significant job opportunities in net-zero-aligned investments, even in the short term.[8,9] More broadly, net-zero-aligned, productive investments that are made across infrastructure, human, natural and social capitals will help build a more innovative, competitive and resilient economy.[10]

The British public remain overwhelmingly supportive of climate action

The "finite pool of worry" hypothesis states that environmental and climate concerns diminish as other worries gain in prominence.[11] Under this hypothesis we would expect that the health and economic concerns associated with the Covid-19 pandemic would have reduced public perceptions of climate change severity or reality.

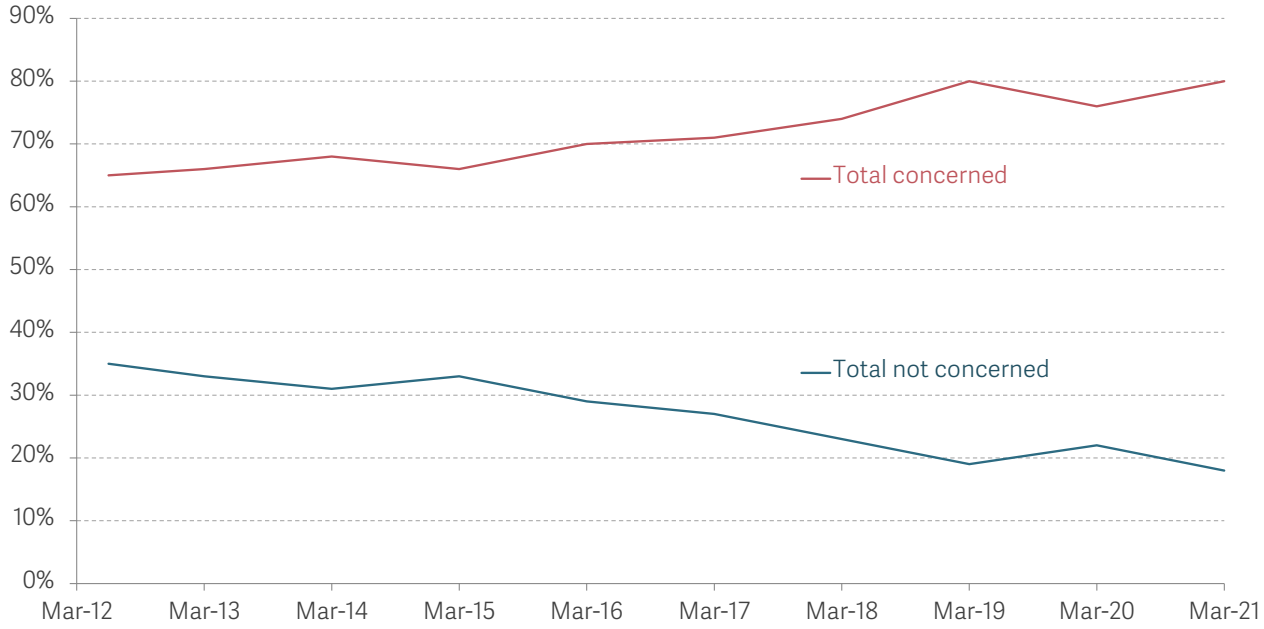
In fact, surveys in the UK and elsewhere since the onset of the pandemic have found little evidence of this.[12] Government-commissioned polling found that 80 per cent of adults surveyed in March 2021 stated that they were concerned or very concerned about climate change – the highest level on record (see Figure 3). YouGov data has showed high concern for the state of the environment throughout the Covid-19 pandemic, when

5 The cost of getting to net zero was described by the OBR as 'significant' but 'not exceptional', but it is notably smaller than the cost of unchecked climate change, which could result in costs that increase public debt to 289 per cent of GDP by the end of this century.
6 IPCC, Special Report on Global Warming of 1.5°C, October 2018.
7 R Martin et al., Innovation for a strong and sustainable recovery, CEP LSE, December 2020.
8 T Christie-Miller and A Luke, Greening the Giants, Onward, March 2021.
9 S Unsworth et al., Jobs for a strong and sustainable recovery from Covid-19, LSE CEP, October 2020.
10 N Stern et al., Strategy, investment and policy for a strong and sustainable recovery: An action plan, LSE CEP, July 2020.
11 N Stern and A Valero, Innovation, growth and the transition to net-zero emissions, LSE CEP, November 2021.
12 A Leiserowitz et al. Politics & global warming, Yale Programme on Climate Change Communication, April 2020.

it was listed as the third largest concern behind health and the economy.[13] Recent polling saw climate change surpass the economy as the second most important issue facing Britain, behind only Covid-19.[14]

FIGURE 3: **Public concern around climate change is consistently high and growing**

Proportion of survey respondents who said they were either very concerned or concerned about climate change, and those who are not very concerned or not at all concerned, UK



NOTES: 2012 value recorded in June as a comparable question was not asked in the March tracker.
SOURCE: Analysis of BEIS Public Attitudes Tracker data.

The next set of changes is likely to be much more disruptive, with more potential for clear winners and losers, than progress in recent decades

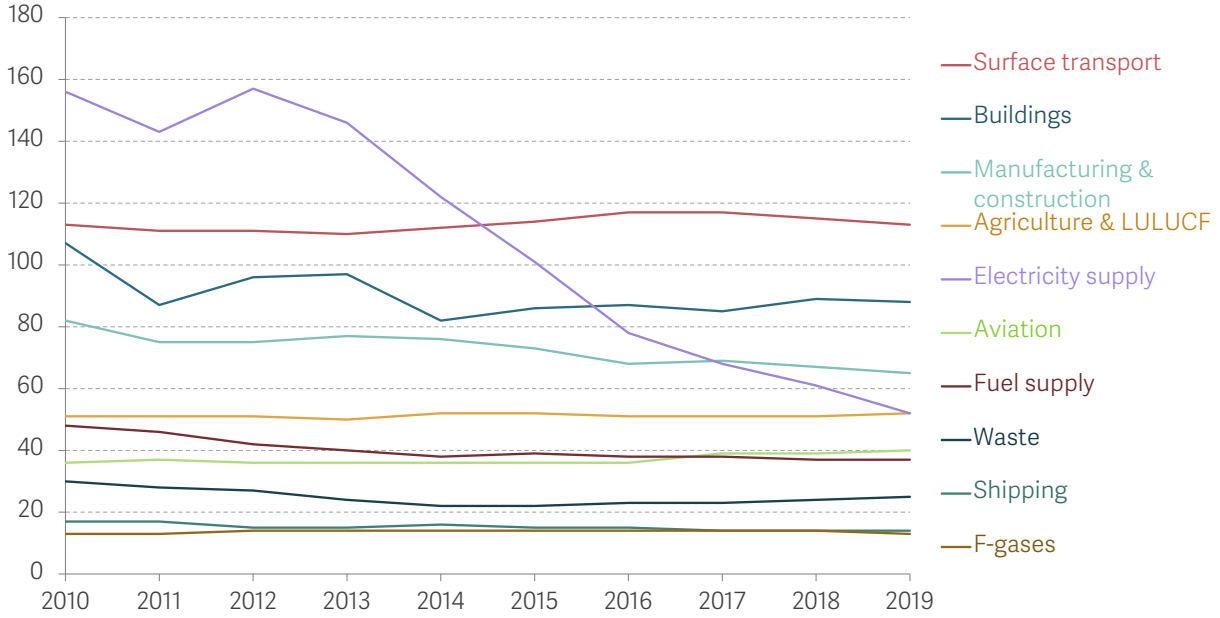
The majority of the UK's decarbonisation journey thus far has been 'behind the scenes', largely occurring without the public knowing or being involved. Impressive progress in virtually ending the use of coal for electricity generation and increasing renewable output has seen greenhouse gas emissions from electricity generation fall by 65 per cent since 2010 (see Figure 4).[15] Picking this 'low-hanging fruit' allowed the UK to reduce overall emissions without significant changes for households or most firms. The consumer who switches on a light switch will not discern any difference between using electricity generated in a coal power station or by an offshore wind farm. By contrast, emissions

13 Yougov, The most important issues facing the country, September 2021.
14 M Clemence and G Skinner, Public concern about climate change and pollution doubles to a near-record level, Ipsos MORI, August 2021.
15 In line with government assumptions, this figure does not include smokestack emissions from biomass generation.

from surface transport are virtually unchanged from 2010, and those from residential buildings have actually increased by one million tonnes per year over the past decade.[16]

Crucially, the next phase of the UK's transition will involve greater focus on sectors such as these, as well as diet, aviation and industry. This will be much more visible to the public, requiring consumers – as well as producers – to undergo some form of change.

FIGURE 4: **Decarbonisation has been concentrated in a small number of areas**
Territorial greenhouse gas emissions by sector, $MtCO_2e$: UK



NOTES: 2020 data excluded because emissions were significantly affected by the response to the Covid-19 pandemic.
SOURCE: Analysis of CCC 2021 Progress Report to Parliament.

The Government has an excellent track record on setting targets, but less so on implementing policies to curb emissions

The recent period of introducing ambitious targets saw the UK Government receive plaudits for its climate ambition. At the same time, however, there has also been widespread – and entirely justified – criticism of the lack of concrete policies to achieve these goals.

The Government's current flagship net zero document, the "Ten Point Plan for a Green Industrial Revolution", contained policies sufficient to reduce carbon emissions by 180 million tonnes from 2023-32.[17] This level of decarbonisation is just over half (55 per cent) of that needed to close the gap on the Fourth and Fifth Carbon Budgets, which were set

16 We focus on emissions in 2019, as those in 2020 were significantly impacted by the response to the Covid-19 pandemic.
17 2023-32 is the period covered by the Fourth and Fifth Carbon Budgets. See: The ten-point plan for a green industrial revolution.

to be consistent with the now-out of date 80 per cent emissions reduction target, instead of reaching net zero by 2050.

More strategies, plans and frameworks are anticipated in the run up to COP26, culminating in the Treasury's Net Zero Review and the Net Zero Strategy. If they are to be successful, these documents will need to set out comprehensive and ambitious policies, be clear about future funding or support mechanisms, and provide an analysis of how any change that results will be well-managed.

Net zero needs to be mainstreamed into the UK's core economic model if we are to tackle the forthcoming decade of change

Since the net zero target was legislated for in 2019, public debate has largely been between those arguing for more ambitious targets or arguments over which technologies should be pursued, and those pointing to overall investment costs as a reason to slow decarbonisation. Successfully navigating the transition will require policy makers to rise above this debate, combining tangible delivery on decarbonisation, honesty about the costs involved, and – crucially – ensuring that lower income households are protected from unfair cost burdens and able to share the benefits of decarbonisation.

As such, we set out a three-part agenda that will position net zero at the core of the UK's economic model:

- Wrestling with **change**.
- Managing **costs** fairly.
- Updating our economic strategy to reflect the fundamental changes in **context**.

Climate policy has historically been viewed in isolation, separated from and (until recently) perceived as running contrary to wider governmental goals such as economic growth, raising living standards and reducing inequalities.[18] This approach will have to change. Decarbonisation will be a major driver of economic change over the next three decades, imparting profound effects on people, on places, and on firms. The shape of these effects will depend almost entirely on government policies. While "clean growth" was one of the "grand challenges" running through the then-government's 2017 Industrial Strategy[19], and net zero is emphasised in the 2021 "Plan for Growth"[20], a long-term framework for industrial policy[21] – with sustainability at its core – is still lacking.

18 The long-held notion that decarbonisation was incompatible with economic growth held for years before being proved incorrect in 2017 when it was observed that the UK had both cut emissions and grown its economy faster than other G7 nations. See: 25 years after Rio, UK leads G7 in both economic growth and carbon cuts. This mantra has been taken aboard by Government since, through the notion of Clean Growth.
19 UK Government, Industrial Strategy: building a Britain fit for the future, November 2017.
20 HMT, Build back better: our plan for growth, March 2021.
21 LSE Growth Commission, UK Growth, a new chapter, February 2017.

In future, it is essential that net zero is considered alongside other economic drivers, such as the recovery from Covid-19, Brexit, the UK's ageing society, technological change, and the need to address spatial inequalities via "levelling up". Only by mainstreaming climate policy into the UK's core economic model will the transition be as smooth as possible, with as many benefits – such as new and growing industries, cleaner air and improved health – captured.

This coordinated approach has generally not so far been seen in domestic climate policy, with short-term policies butting up against each other and occasionally counter-acting each other.[22] As such, the economic impacts of UK climate policy have not been spread equitably across society, and large numbers of green jobs have been realised in other countries instead of in the UK.[23] There has also been a notable absence of assessing the distributional impact of policies before their implementation, an oversight that has led to a number of unintended consequences – for example, clean heat initiatives and support for rooftop solar generation being largely taken up by wealthier households, or the 2001 decision to alter the tax system in favour of diesel cars which led to surging air pollution in urban areas, among others – that have, in turn, required policy or regulatory interventions to put right.[24] But there have been successes to learn from too – such as the 2005 ban on non-condensing gas boilers, and targeted efficiency schemes such as the Energy Company Obligation (ECO) – which have worked well, cutting emissions at the same time as boosting living standards for the less well-off parts of society.

There are very real challenges along the way to net zero, but also opportunities that can lead to sizeable benefits to the UK economy. The remainder of this paper sets out a trilogy of policy questions – change, costs, context – providing the agenda for the Economy 2030 Inquiry over the coming two years.

Change

The nature of decarbonisation required in this decade and beyond will have a significant impact on daily lives of millions of families

While the UK has cut emissions by nearly half since 1990, it is far from half way to net zero – the remaining half will be much more difficult. The changing nature of decarbonisation in the UK over coming decades will require major policy-driven shifts and economy-

22 This policy incompatibility can be seen through measures to support electric vehicle take up, such as the plug-in car grant running contrary to a tax system that favoured petrol and diesel cars for fleet purchases and led to fuel duty being frozen since 2010; or exposing industrial processes to the EU emissions trading scheme before compensating them for all pollution costs by issuing free allowances; or the short-lived Green Homes Grant available briefly during 2020-21 that was implemented poorly and withdrawn with such haste that it could reduce take-up of future home insulation schemes.

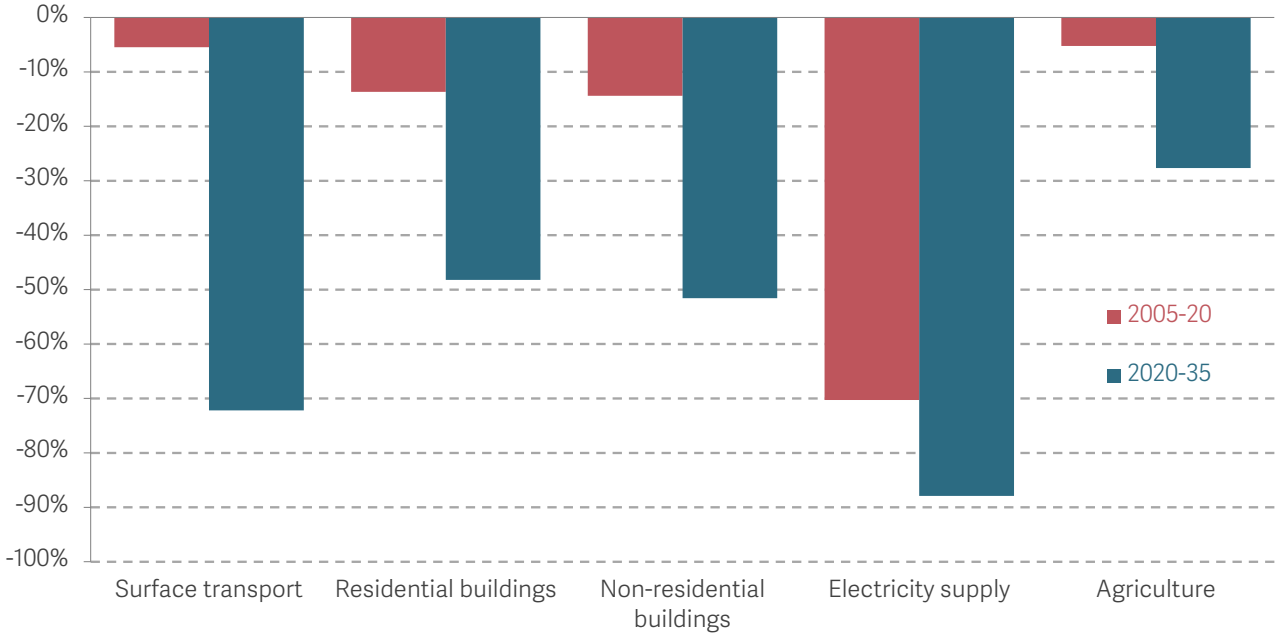
23 E Gosden, More than half of £50bn wind farm cash to go overseas, Times, November 2020.

24 For example: National Audit Office, Low carbon heating of homes and businesses and the Renewable Heat Incentive, February 2018 and National Audit Office, Controlling the consumer-funded costs of energy policies: The Levy Control Framework, October 2016.

wide changes that will have significant impacts on the lives of citizens across the UK. For example, the CCC's Balanced Pathway to 2035 would see emissions from surface transport fall by 72 per cent compared to 2020, emissions from buildings fall by 48 per cent and emissions from agriculture be 28 per cent lower, all dramatic increases in the pace of reduction seen over the previous 15 years (see Figure 5).

FIGURE 5: **The pace of decarbonisation needs to increase in a number of sectors**

Per cent reduction in historical sectoral emissions from 2005-20 and those forecast from 2020-35 under the CCC's Balanced Pathway



SOURCE: Analysis of CCC data.

These testing goals will, by their very nature, require both societal and behavioural change, impacting people as consumers and as workers. The CCC estimate that 59 per cent of remaining decarbonisation out to 2035 requires some form of societal or behaviour change, compared to 41 per cent that can be achieved by technological advances or fuel switching alone (Figure 6).[25] This compares to an estimated 13 per cent of decarbonisation from 2009-2019 that involved changing behaviours.[26] From cars and charging points, to insulation and heating systems, changes in production and consumption will have significant impacts on the daily lives of citizens across the UK.

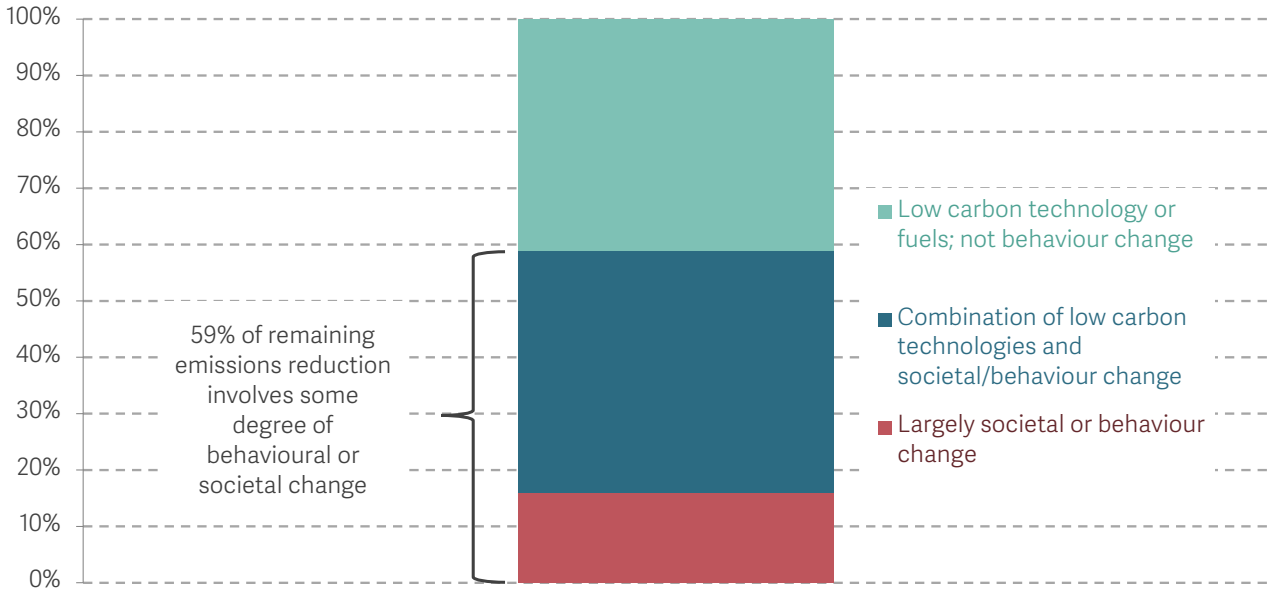
Change can be both good and bad, but is almost always disruptive, with different households resilient to this disruption to greater and lesser extents. The changing nature of decarbonisation will directly impact households, with the degree of change almost

25 R Carmichael, Behaviour change, public engagement and Net Zero, October 2019.
26 B Meyer and T Lord, Planes, Homes and Automobiles: The Role Of Behaviour Change in Delivering Net Zero, Tony Blair Institute for Global Change, August 2021.

entirely a function of government policy; as such it is imperative that decisions are made to shepherd this change, ensuring that the ability of people, places and firms to maximise 'good' change and minimise 'bad' is a key consideration.

FIGURE 6: **Decarbonisation from 2020 to 2035 will have a much greater impact on the public sphere than that to-date**

Proportion of decarbonisation from 2020 to 2035 that requires behavioural or societal change and that which can be achieved through technology or fuel switching alone



SOURCE: Analysis of CCC data

This changing nature of decarbonisation, and urgency at which radical change is needed, will cause disruption – good and bad – across the country. Only by understanding and addressing the scale of this challenge can this disruption be controlled, minimised or negated, reducing the risk of net zero negatively impacting living standards.

But despite the high levels of public support for the move to net zero, only recently has the national debate started to touch on what changes in lifestyles may be needed as decarbonisation continues into the 2020s and beyond.[27] The scale of the emissions that result from using fossil fuels to heat homes, and from meat-heavy diets, are entering the national conversation, but it is not yet clear if they are as well understood as emissions resulting from driving or flying, for example.

This challenge is not helped by a long-running absence of clear communications from Government detailing the changes that net zero will require (as well as the glaring

27 The largest impact on people's lives is likely to occur as homes are decarbonised, most likely with switching fossil fuelled boilers for heat pumps that can operate on zero carbon electricity. The term 'heat pump' was mentioned just 68 times in UK national media in 2016, rising to 1205 in the first eight months of 2021, data from Factiva shows.

lack of policies to get us there). Lessons can be learned from the pandemic, which has demonstrated how society can change behaviour when the need to do so is understood, how resources can be mobilised quickly towards collective goals, and the types of support mechanisms that can be generated quickly for specific sectors or groups affected. The potential (global) impacts of the climate crisis will be slower to materialise, but are grave, and the actions which need to be taken are no less urgent.[28] All of this points to the need for effective and coordinated management and communication of change.

The transition to net zero will impart widespread but differing changes on industries and labour markets

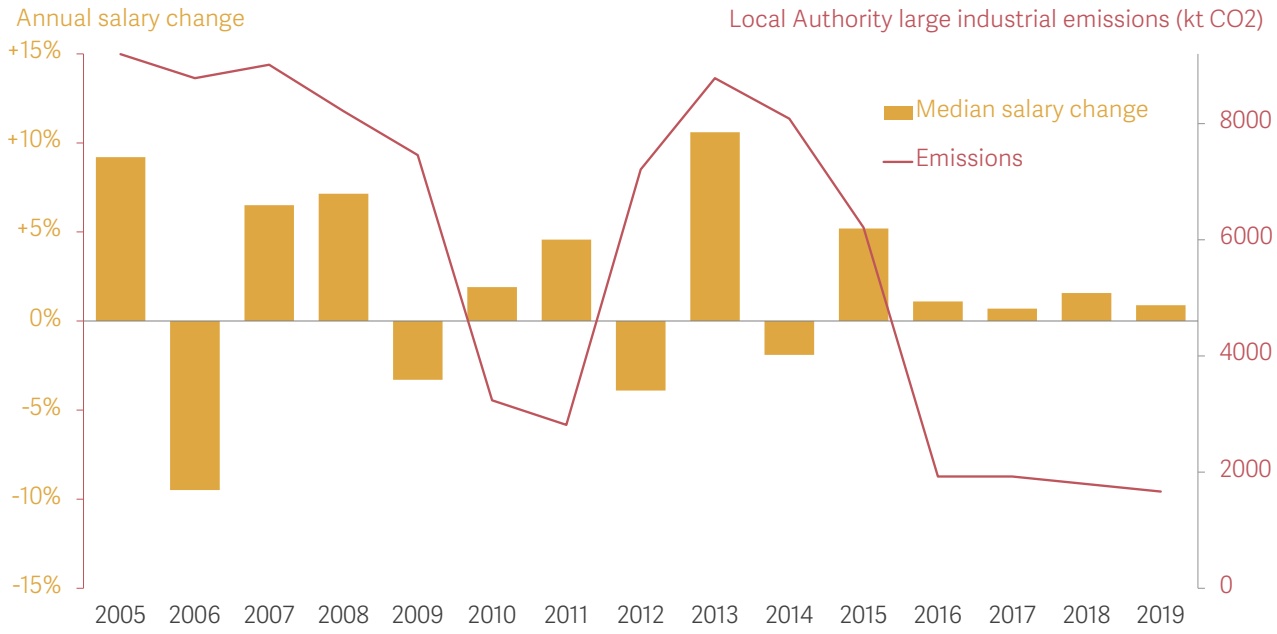
Decarbonisation represents a major economic change, with many sectors and regions set for significant shifts. 'Clean growth' will lead to new green jobs, the loss of some existing employment, a geographical shift in economic activity, and demand for new sets of skills.[29] There is a clear opportunity here – one that is often touted by the Government – to move toward an 'upskilled' workforce, but this transition will not be smooth without advanced planning, targeted local investment, and support through training and policies that give businesses enough certainty to invest in workers.

Lessons can be learnt from overseas, as well as previous instances of structural change such as de-industrialisation in the North of England or the rapid growth of renewable energy jobs along the North Sea coastline.[30] For example, data from Redcar in North East England, an area that has undergone cycles of substantive change, shows how tightly emissive industry and local salaries can be linked. Redcar's steel mill, historically one of the town's largest employers was mothballed in 2010, re-opened in 2012 and finally closed in 2015. As Figure 7 shows, this to-and-fro had a clear impact on local salary growth.

28 C Hepburn et al., Will Covid-19 fiscal recovery packages accelerate or retard progress on climate change?, Oxford Review of Economic Policy, May 2020.
29 The Government recently commissioned a Green Jobs Taskforce to bring together evidence on the skills needed for our transition to net zero.
30 C Beatty and S Fothergill, The long shadow of job loss: Britain's older industrial towns in the 21st century, August 2020.

FIGURE 7: **Industrial regions are particularly at risk of disruptive change from decarbonisation**

Annual industrial CO_2 emissions and change in median salary, Redcar



SOURCE: Analysis of BEIS, ONS ASHE data

The responsiveness of local salaries to industrial output is also felt in other parts of the UK. For example, Port Talbot in South Wales is largely reliant on employment in TATA's steel mill, employment in Crawley in Sussex is heavily responsive to the changing economic fortunes of Gatwick Airport, and the carbon footprint of employment in Selby in North Yorkshire is particularly high due to Drax's position as a major employer, to name a few.[31]

Different areas will require different approaches to decarbonisation, with tailored solutions needed to account for a litany of conditions and factors. Support needed to capture the upsides of net zero, such as ensuring there is sufficient training to allow local residents to benefit from new low-carbon employment opportunities, will also differ with geography. Recent lessons from the now-defunct Industrial Strategy shows how local economies can be recalibrated around green industries, improving the living conditions of local families whether employed in these sectors or not.[32]

Net zero brings decisions that will change the future of British industry

There are a number of levers that Government can pull to support new technologies and industries in order to meet decarbonisation and/or broader growth objectives. Which of

31 See, for example: T Christie-Miller and A Luke, Greening the Giants, Onward, March 2021. Crawley's reliance on Heathrow as an employer is also highlighted by Crawley's persistently high furlough rates during the Covid-19 pandemic as passenger numbers through Gatwick Airport were severely depressed. See: D Tomlinson, The beginning of the end, Resolution Foundation, July 2021.

32 UK Government, Industrial Decarbonisation Strategy, March 2021.

these to employ, how, and when, all require decisions that will shape the future of the British economy.

Mechanisms including direct support for technology and innovation, de-risking investment, tax changes, regulation and standards, and public engagement measures can be employed either as standalone measures or, ideally, in a coherent and complementary way. Every policy area will bring with it a large number of decisions on which areas to prioritise and on detailed aspects of policy design.

These decisions will involve trade-offs, too. For example, de-risking renewable energy investments through the 'Contract for Difference' – one of the UK's most successful decarbonisation policies – has seen the cost of renewable energy plummet. This tool, however, created an investment environment in which companies were incentivised to seek ever-lower costs, with the result that a large number of jobs were created in lower-cost economies than in the UK.[33]

Additionally, in a move largely regarded as a poor execution of industrial policy, the UK's promotion of offshore wind boom has bolstered the Danish company Orsted, which is now the world's largest offshore wind developer, and is a more valuable company than oil supermajor BP.[34] On the other hand, some recent decisions have worked in a more positive direction. The fact that the UK took a lead on the phase-out date for non-electric vehicles was cited by both Nissan and Vauxhall as drivers behind their new investment in car production lines, with thousands of low-carbon, long-term jobs secured in Sunderland and Ellesmere Port a result.

Imminent decisions on the UK's hydrogen economy and on how to heat homes, among many others, will need to consider myriad trade-offs and their impact on the economy as a whole. For example:

- does the UK need a domestic hydrogen industry or can it import from overseas?
- what will be the most effective uses of hydrogen, and how can the UK ensure it is used in the highest value application?
- how can the cost of installing a heat pump be made lower? and:
- what is the most effective strategy for improving the fabric efficiency of hundreds of thousands of different designs and types of home?

The impact of these and other decisions is a function of government policy, within which there is a priority to ensure that state investment and support is well targeted and that it catalyses private investment. Without rigorous assessment, though, these choices will be

33 E Gosden, More than half of £50bn wind farm cash to go overseas, The Times, November 2020.
34 J Ambrose, BP market value at 26-year low amid investor jitters, The Guardian, October 2020

made blind and therefore more likely to backfire. History is littered with policies that have not delivered value for money, or have not corrected market failures; a successful net zero transition will have to make as few of these mistakes as possible.

Costs

The current debate around multi-decadal, economy-wide costs masks crucial impacts that will be the determining factor in how net zero is delivered

There are clear costs to net zero, just as there are clear benefits. Skilful control and management of how these are shared requires a thorough understanding of the main challenges and opportunities:

- At the aggregate level, the CCC's estimate of the net costs to the UK of moving to net zero – currently pegged at around £300 billion over three decades – appear manageable, and unlikely to have a significant negative impact on overall living standards.
- However, these aggregate costs hide a crucial temporal imbalance with capital investment costs pre-dating savings by years or decades; however this burden is shared, this likely means a reduction in consumption in the short term.
- The distribution of costs is also key, and mismatches between who pays and who benefits need to be understood and planned for to ensure a fair transition that commands popular support.

We explore these points in turn below, before using this framework to look at two key challenges of the next decade: decarbonising domestic properties and surface transport.

In aggregate, the costs of the net zero pathway are manageable

Much of the current political debate around net zero is focused on the costs of decarbonisation. The investment needed out to 2050 has been estimated by the CCC as £1.4 trillion, with close to £1.1 trillion of this offset by reduced operating costs of low carbon technologies. Within this total, buildings, surface transport and electricity production are the three main areas in which costs (in the form of new capital investment) will be incurred, with most of the savings coming through lower transport costs.

Netting off the cost savings from the cost of investments gives a net cost of c.£300 billion over three decades (as shown in Figure 8). [35] This is entirely manageable, accounting for less than 1 per cent of GDP over the next 30 years.

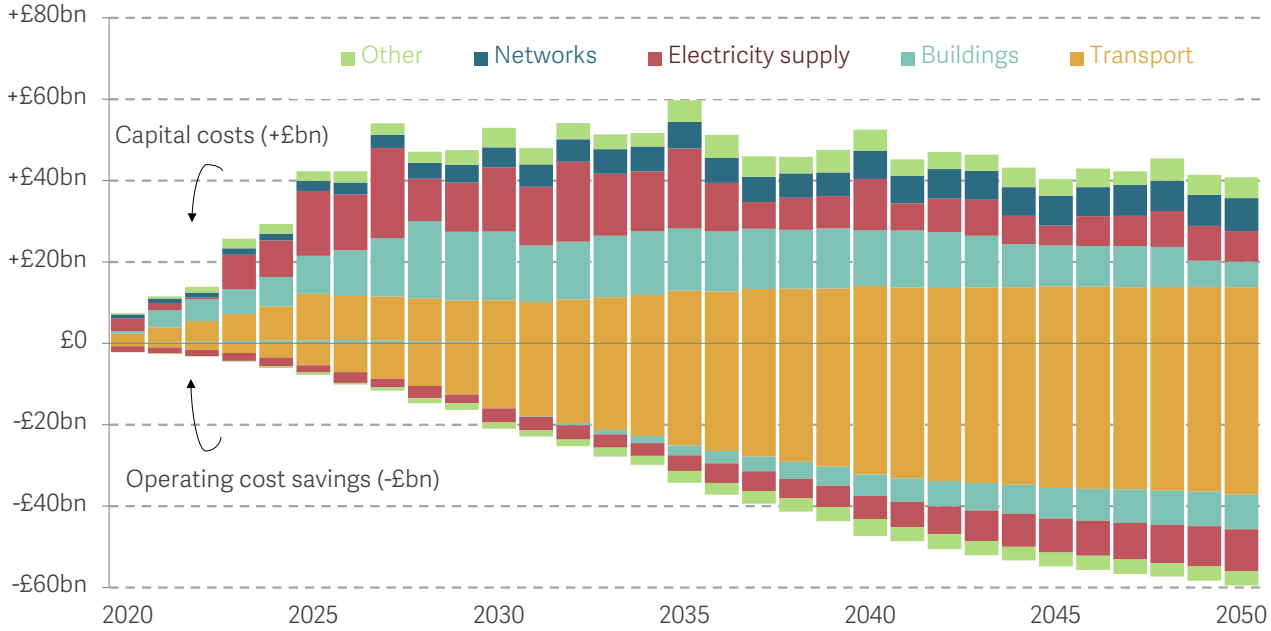
35 Climate Change Committee, Sixth Carbon Budget, December 2020.

Since the net zero target was passed into law in 2019, the debate around its costs has largely swung between opponents who use selective headline costs as reason to limit efforts to cut carbon, or campaigners who focus solely on the upsides and ignore the very real costs. Effective management of the transition requires adopting a more sensible position, accepting that there are both sizeable costs and benefits, plotting a route that ensure these are shared as justly as possible and that efforts are focussed on measures to bring down the costs of new technologies.

Indeed, past evidence on the rate at which clean technology costs have fallen means the eventual cost could end up lower.[36] For example, when the CCC estimated the cost of the original Climate Change Act target – an 80 per cent reduction on 1990 emissions by 2050 – they concluded it would be equivalent to roughly 1 per cent of GDP. When it carried out the same exercise for the net zero target, technological developments in the intervening 11 years meant that the expected cost to the economy had not changed, despite the more challenging emissions target.[37] However, the transition will certainly involve large capital investment costs and lower consumption as a result, requiring a thorough assessment of who pays, and when.

FIGURE 8: **The path to net zero involves greater investment through to 2035, most of which is paid back in later savings**

Capital investment costs and operating cost savings in the CCC balanced net zero pathway



NOTES: Values above the x-axis refer to additional annual capital investment. Values below the x-axis refer to savings that result from reduced operating costs
SOURCE: Analysis of CCC data

36 T Jennings et al., Policy, innovation and cost reduction in UK offshore wind, UCL and the Carbon Trust, July 2020.
37 Certainly the cost of some of the technologies needed to reach net zero continue to fall at great pace. See, for example: S Evans, Record-low price for UK offshore wind cheaper than existing gas plants by 2023, Carbon Brief, September 2019.

The temporal imbalance between costs and savings, and the fact that most of the savings come from lower transport costs, brings risks that need to be managed

As well as the overall scale, the timing of costs and benefits is also important. The CCC's cost projection features capital investment costs peaking in the late 2020s and early 2030s, largely offset by savings in operational costs in later years. In particular, the CCC's path to net zero requires annual net investment of £27 billion per year over the decade ahead (2021-30), £15.9 billion per year in the 2030s, before an average annual net payback of £11.2 billion in the 2040s.

Although the net cost is manageable in aggregate, this is of little help to households presented with a bill of several thousand pounds to decarbonise the family home in 2025 and promised that savings will accrue from lower transport costs in the 2030s and 2040s, on the proviso that they own and use an electric car.

This temporal imbalance is one of the main risks associated with reaching net zero, clearly requiring planning and action from across Government. As we discuss in the next section, the distribution of costs and benefits between different households will depend on policy choices made by the government. But however the costs are split between the public purse, businesses and households, it is likely that the end result is that household consumption will be reduced, either through higher taxes, reduced profits or households having to bear upfront costs themselves.

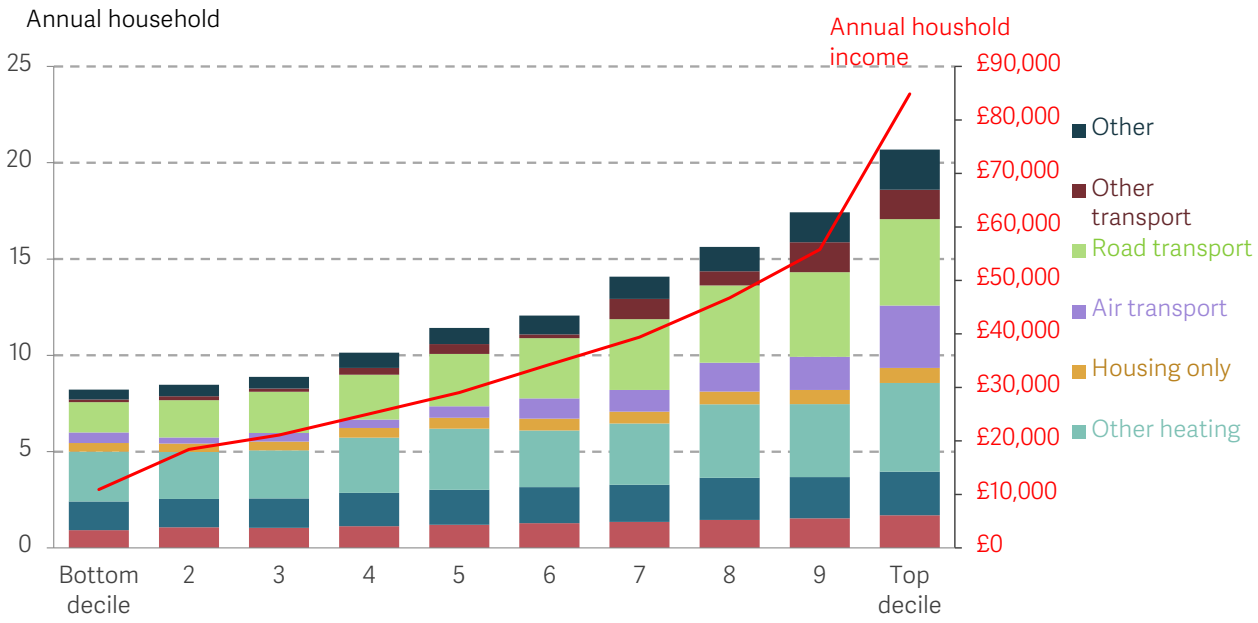
Changing consumption will affect households in different ways

The way that net zero changes households' consumption and impacts on their living standards – both positively and negatively – will be a function of income, location, family type and a myriad of other factors. But better air quality and local economic growth in urban areas will not quell concerns in rural regions should new agricultural practices and means of managing land negatively impact economies and labour markets. So it will be essential to ensure that any change is as smooth as possible, and as equitable as possible.

Currently, it is the richest households that have the largest carbon emissions: annual household emissions for the richest 10 per cent are more than double that of the poorest (see Figure 9). The major driver of this difference is greater use of road and air transport in households higher up the income spectrum; there is comparatively little variation in emissions from home energy use.

FIGURE 9: **Higher-income households have more carbon-intensive lifestyles than those that are less well-off**

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

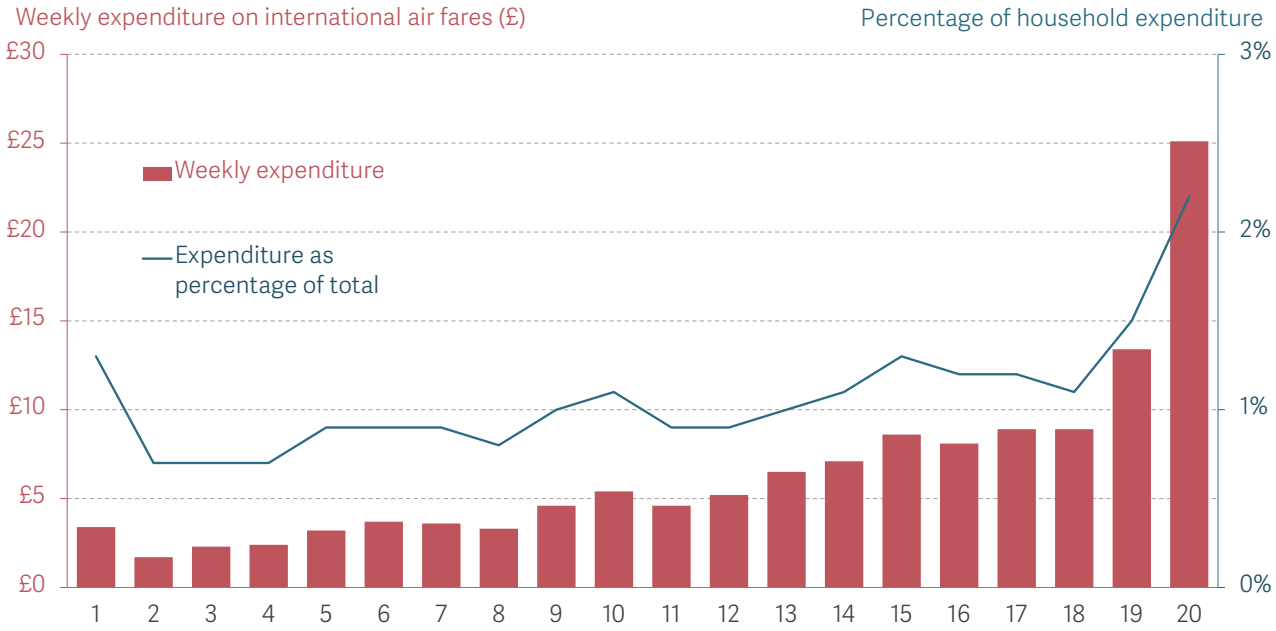


NOTES: This work was originally published in HM Treasury's Interim Net Zero Review, published in 2020.
SOURCE: Data provided by HM Treasury.

Analysis on this level will not provide the insights required, with intra-decile deviation needing to be factored into policy making. As discussed earlier, nearly half of the lowest income homes do not have access to a car, while the top income vigintile has a weekly expenditure on international air fares close to double that of the vigintile below (see Figure 10). Examining and understanding these variations is vital in managing the transition to net zero.

FIGURE 10: **Expenditure on aviation is heavily skewed towards households at the top of the income distribution**

Average weekly household expenditure on international air fares: 2015-16 to 2017-18, UK



SOURCE: ONS Living Costs and Food Survey

It is not just the income spectrum across which costs and benefits risk being unevenly spread. Different sectors of the economy and different geographic regions will also be exposed to the economic impacts of the net zero transition in different ways. This will be true both for changes in consumption and for growth or declines in employment, and will require significant and detailed analysis to understand, enabling effective policy making.

But where costs and benefits eventually land depend critically on government policy choices

Although there is little that governments can do to affect the time profile of the costs and benefits of moving to net zero (at least, not without significantly increasing the overall net cost), there is a great deal that they can do to determine the distributional impact of those costs.

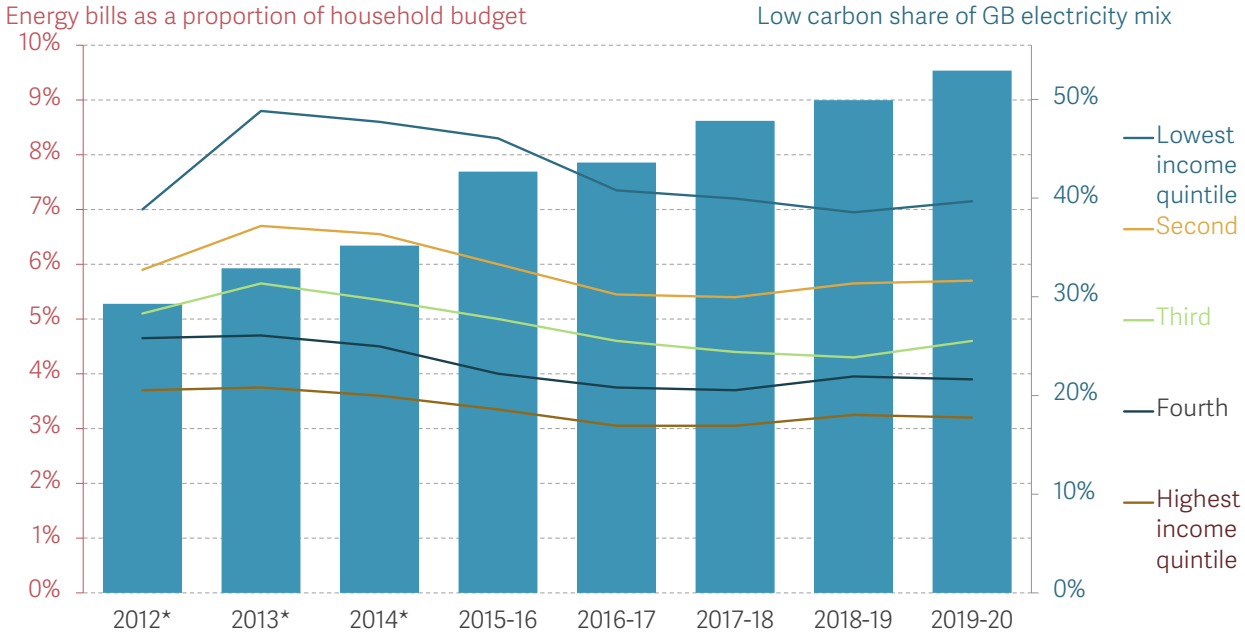
This is important, as there is a clear risk here is that poor management of investment and running costs would see the burden fall on the shoulders of those least able to pay.

Looking back allows us to understand the impact of policy decisions on consumer costs, understanding what worked well and what did not. For example, as we said earlier, electricity decarbonisation has done most of the heavy lifting in terms of territorial emissions cuts, but this has occurred largely through a system in which the money invested in renewable energy generation have been funded via a levy added to

electricity bills. Given that energy bills account for a larger proportion of household budgets in lower-income households than they do in richer households (see Figure 11), this has ended up being a significantly more regressive route than, for example, funding the increased capacity in renewables via general taxation, something rejected at the time through political considerations.[38],[39] As it happens, although decarbonising the power grid has led to an increase in unit costs, simultaneous reduction of energy use – improved efficiency of consumer goods and heating systems meant that the average home consumed 19 per cent less electricity in 2019 than it did in 2010, with gas use also down by 18 per cent over the same time period – has prevented this pushing up domestic bills.

FIGURE 11: **Decarbonising electricity supply has not led to energy bills adding pressure to household budgets**

Domestic energy bills as a proportion of household budget, by quintile, and the share of electricity from low-carbon sources



NOTES: Pre-FY2015-16 ONS data was produced in calendar years, therefore Q1 2015 is not shown, Electricity generation data shown calendar years for 2012-2014, financial years 2015/16 onwards. Biomass assumed to be zero carbon, in line with Government accounting methods.
SOURCE: Analysis of ONS LCFS, BEIS data

But this tension remains now (as we can see in the debate about the spike in energy prices): anything that increases energy costs without reference to household incomes will impact the finances of poorer families to a larger extent than those with higher incomes. Learning from these instances, and implementing policies or regulations to

38 See, for example: A Owen and J Barrett, Reducing inequality resulting from UK low-carbon policy, Climate Policy, 2020
39 It was also not thought sensible to add levies to gas bills, as this would mean that households in homes not connected to the gas grid would contribute less than those with a gas connection, something that is now providing a disincentive for households to switch out of gas and into electricity for their home heating and cooking needs.

correct for unintended consequences of measures designed to cut emissions, is likely to be a significant component of the UK's journey to net zero.

Case study 1: the challenges associated with decarbonising buildings must not be overlooked

The CCC 'Balanced Pathway' forecast shows that the largest annual capital outlays over the coming decade will be on homes, a large part of which will be working toward the Government's goal of increasing the EPC rating of as many homes as possible to at least C by 2035.[40]

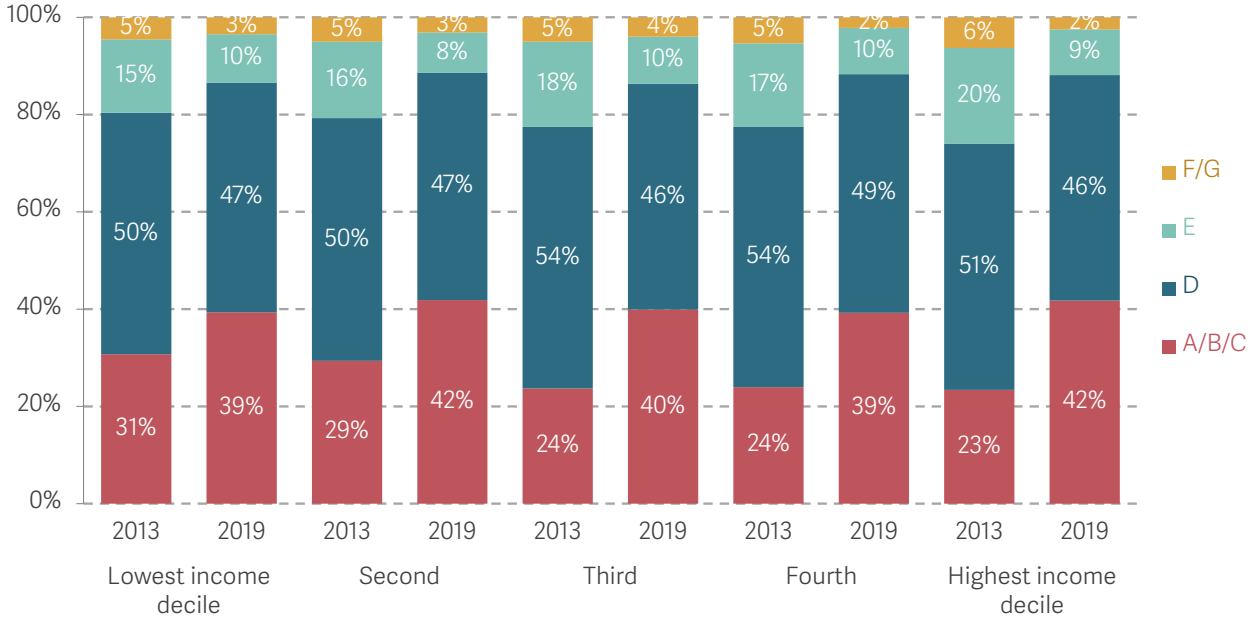
Over the decade 2022-31, the CCC's forecast assumes a capital spend of £39 billion on fabric efficiency (insulating walls and roofs) and £37 billion on clean heat. The OBR's central forecast – in which it sets out the possible implications of net zero for government finances – assumes that 44 per cent of the cost of decarbonising residential buildings will be borne by the taxpayer, with the rest coming from homeowners, landlords and freeholders.[41] Together, these two forecasts imply a bill of more than £42.5 billion for property owners, or slightly over £1,500 per (physical) property over the following 10 years.[42] But the actual costs faced by individual households will vary considerably around this average; even more importantly, so will the ability of households to absorb such costs.

Survey data shows a general increase in residential building efficiency since 2014, with both the proportion of households living in EPC band C or above increasing, and those living in the worst-performing properties falling (see Figure 12, although figures refer to England only). However, those at the top of the income distribution have seen a greater increase in efficiency. The fact that this has occurred against a backdrop of government support for energy efficiency that has been targeted largely at households in fuel poverty is an indication of the uncertain outcomes of policies aiming to decarbonise Britain's housing stock.

40 As outlined in the government's Clean Growth Strategy.
41 This figure refers to the OBR's central scenario, see: OBR, Fiscal Risks Report, July 2021.
42 Note that there is significant uncertainty about how much a heat pump will cost in the future, with industry estimates already notably lower than figures used in CCC projections.

FIGURE 12: **Home energy efficiency has increased, although the richest households have seen the largest improvements**

Proportion of English homes at different Energy Performance Certificate (EPC) ratings by household income quintile: 2013-14 & 2019-20



SOURCE: Analysis of EHS data.

It is useful here to reflect on past experience. There are two general approaches to upgrading the nation's leaky homes: incentivising those dubbed as 'able to pay' to invest in their properties, or having the public sector fund upgrades to homes so that families on stretched budgets see energy costs fall. Both will be needed in the years ahead, but where the dividing line sits will be of the upmost importance. The risk is that a poor management of the large upfront costs needed to decarbonise British homes risks penalising those least able to fund upgrade works themselves. In particular, punitive regulations – such as those imposed at the point of sale – are risky and obviously best avoided. Decarbonising buildings also brings numerous co-benefits, such as lower bills, cleaner air and the health implications of living in a warmer home. It is also vital to ensure that these upsides are available to all. There are – and have been – a number of efficiency policies specifically targeted at fuel poor or low-income households, but they are clearly not commensurate with the pace of change needed.

Case study 2: decarbonising transport may bring the biggest benefits to the better off

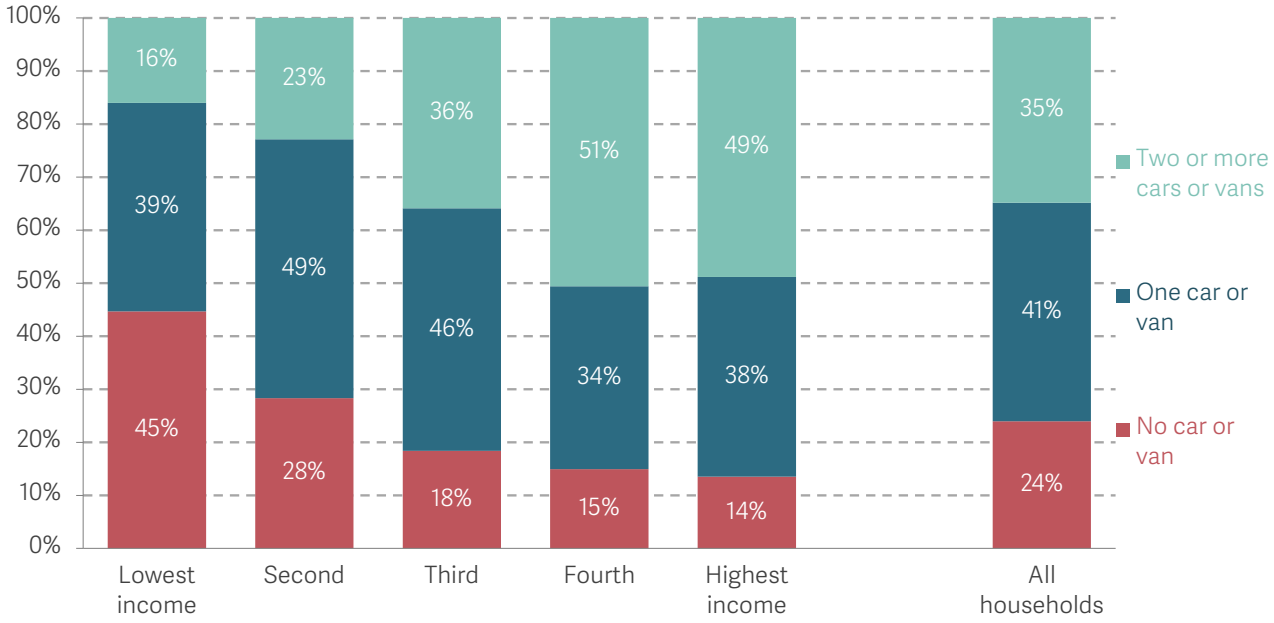
Another major investment cost area, and the main sector through which net zero is likely to lead to cost savings (given the lower running costs of electric vehicles versus those using petrol or diesel), is surface transport. Very sensibly, given it is currently the largest source of carbon emissions in the UK (see Figure 4), the Government has announced a

2030 end-date to the sales of petrol and diesel cars and vans, and is currently consulting on the extent to which hybrid vehicles can be sold up to 2035. This means that the switch to electric cars and vans will be a major trend in the 2020s.

However, as car ownership (especially electric car ownership) is skewed towards high-earning families (see Figure 13), any state support for this switch – whether through grants, infrastructure and continued tax breaks – will benefit those already doing better in life.

FIGURE 13: **Nearly half the lowest-income households do not have access to a car, while a similar proportion of the richest households have two or more vehicles**

Household car availability by income quintile: 2019, England



SOURCE: Analysis of Department for Transport National Travel Survey, 2019

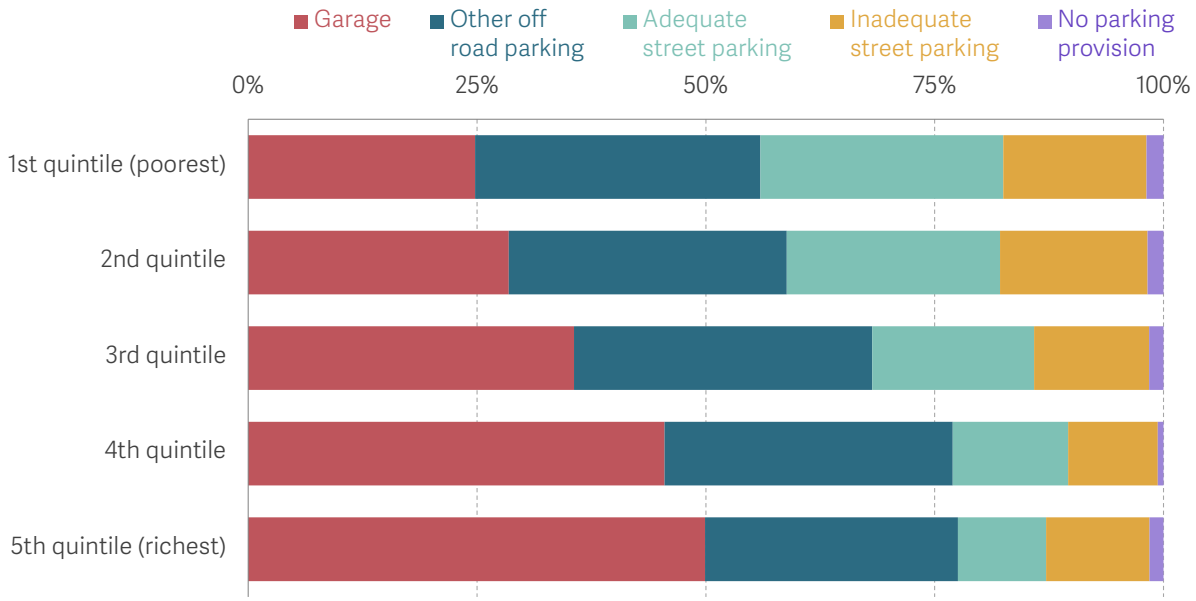
In particular, banking the savings associated with the lower running costs of an electric car requires access to low-cost at-home charging. This is because the cost of charging a car using a public charger can be at least double that of doing so at home, with fast chargers located on motorway service stations a high-cost necessity (charging at home also allows households to fill car batteries with cheaper off-peak electricity while cars are stationary overnight and, as technology develops, will also enable car batteries to be used to arbitrage electricity wholesale and balancing markets, offering payments back to electric car owners who can leave their vehicles plugged in when not in motion.[43])

As well as being more likely to own a car, higher-income households are also more likely to have parking provision: more than three-quarters of the richest households have

43 UK Government, Role of vehicle-to-X energy technologies in a net zero energy system: call for evidence, July 2021.

either a garage or off-street parking (see Figure 14), with lower-income households more likely to use on-street car parking, which is inherently less suitable for electric vehicle charging. As it stands, and without a change to government schemes, the savings associated with carbon-free motoring will be concentrated among the better-off.

FIGURE 14: **Access to garage and off-street parking, and therefore low-cost home EV charging, is higher for wealthier households**
Parking provision by household income quintiles: England, 2019



NOTES: Categories are regardless of car ownership.
SOURCE: Department of Levelling up, housing and Communities, English Housing Survey Live Tables.

As well as running costs, the electrification of surface transport will lead to reduced air and noise pollution, both of which currently have a far from negligible cost.[44] Spreading the uptake of electric cars and vans across the country will allow people from all walks of life to benefit from the end of the internal combustion engine.

Context

The changes required to meet net zero are set to occur against the background of persistently-poor growth in productivity and real wages since the financial crisis, and the effects of Covid-19 on lives and livelihoods.[45] Net zero will also be a direct driver of change, impacting on the way decisions are taken and the environment within which they are made.

This context requires us to make choices about our economic model that are different in substance and style compared to what has come before.

44 Air pollution is one of the biggest environmental threats to health in the UK, with between 28,000 and 36,000 deaths per year attributed to long-term exposure to dirty air. See: Public Health England, Air pollution evidence review, March 2019.
45 T Bell et al., The UK's decisive decade, Resolution Foundation, May 2021.

A new approach to growth, propelled by a process of "creative destruction"[46] with a purpose, whereby new low-carbon technologies emerge and replace their high-carbon counterparts, is now required. Due to a series of market failures and path dependencies in innovation systems,[47] markets will not move towards a green economy at the pace required without active and "directional" industrial and environmental policies that can set expectations and incentives for the private sector. And, given the uneven impacts on workers and consumers discussed previously, an active management of the "destruction" part of the process is required such that growth can be inclusive.

Analysis of comparative advantage in innovation and trade can help identify net-zero-aligned growth opportunities

The UK has strengths that can be leveraged as global markets for clean technologies, products and services grow. The UK's universities, and research system more broadly, are amongst the country's key assets. Despite a consistently underspending in R&D relative to its main comparators,[48] the UK performs well with respect to its research quality and impact.[49] It is well-known that the UK punches above its weight in this regard, being home to less than 1 per cent of the world's population but accounting for 14 per cent of the top-cited 1 per cent of academic publications.[50]

And the experience during the pandemic has further demonstrated the power of UK-based (often publicly-funded) R&D in the development of Covid-19 vaccines.[51] But where do the UK's current and potential innovative strengths lie with respect to the transition to net zero? Given the extent of technological uncertainty and the need for radical change in the coming years, it can be challenging to answer this, and a range of approaches using different datasets are needed to look beyond the 1 per cent of employment and turnover that has been identified as the "low carbon and renewable energy economy" as things stand today.[52]

One approach uses patents data. While not all innovations are patented and some sectors tend to patent more than others, the advantages of this approach include the fact that patents data are available across countries, over time, and technologies can easily be classified as being "clean".[53] Such analyses suggest that the UK has an

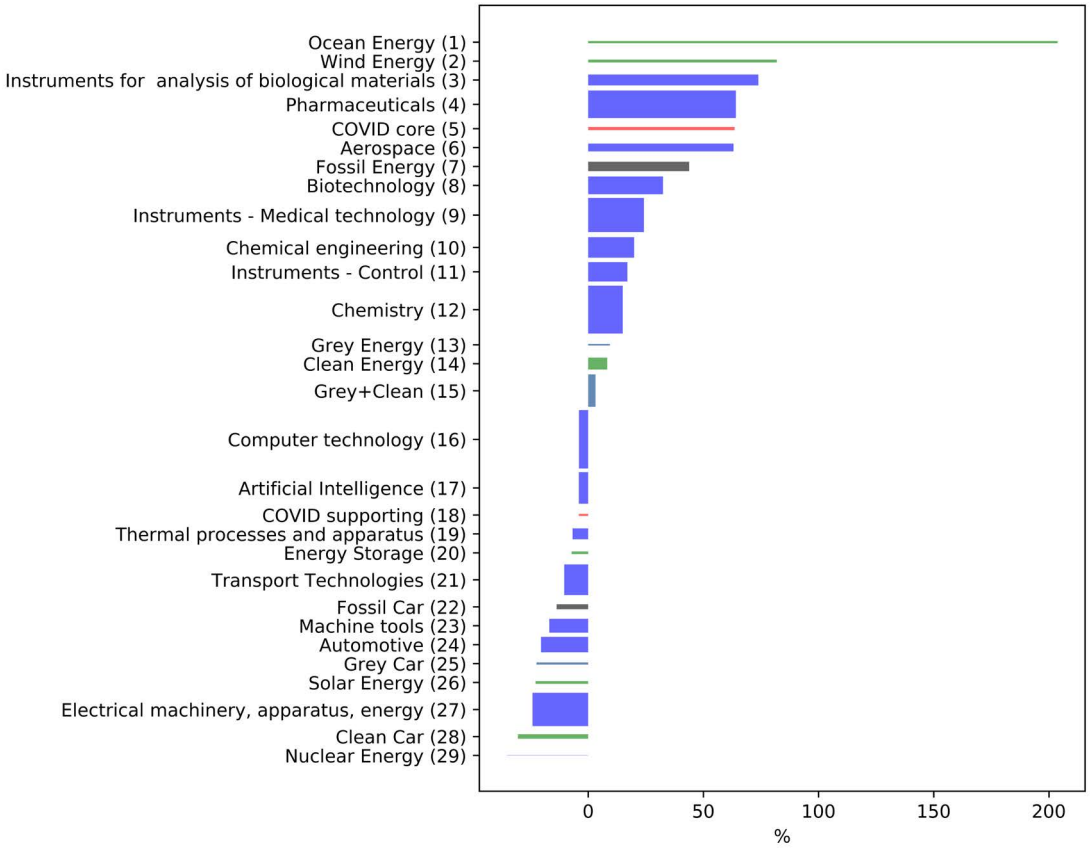
46 P Aghion et al., The Power of Creative Destruction (Chapter 9, Green Innovation and Sustainable Growth), 2021
47 See, for example: P Aghion et al., Path dependence, innovation and the economics of climate change., LSE Centre for Economic Performance, November 2014, and: N Stern and A Valero, Innovation, growth and the transition to net-zero emissions, Research Policy, November 2021.
48 The UK currently spends around 1.7 per cent of GDP on R&D (government and business-funded), compared to over 3 per cent in Germany and the United States.
49 BEIS, International comparison of the UK research base, 2019.
50 This statistic relates to field-weighted citations to account for differences in citations over time and differences across disciplines and types of document, BEIS(2019)
51 S Cross et al., Who funded the research behind the Oxford-AstraZeneca Covis-19 vaccine? April 2021
52 The ONS has estimated that the LCREE accounted for 1 per cent of non-financial employment in 2019 and 1% of total non-financial turnover in 2018, see: ONS, Low carbon and renewable energy economy, UK:2019.
53 The European Patent Office Cooperative Patent Classification (CPC) system for categorising patents in different technology 'classes' includes a specific class ('Y02') related to climate change mitigation technologies.

important role to play in terms of generating new ideas and technologies that can help the world to decarbonise, and in so doing, can potentially reap some of the associated growth benefits in the UK.

A starting point is to consider areas where the UK has a "revealed technological advantage" in different technology classes. This occurs where the UK's share of patents in a particular technology field is higher than the global share in that field, has been found to be case in some areas of clean energy, in particular in ocean and wind (as shown in Figure 15).[54]

FIGURE 15: **UK "revealed technological advantage" in key areas of innovation**

Revealed technological advantage (RTA) (length of bar) and number of patents (width of bar), by sector



NOTES: The length of each bar on the horizontal axis shows the revealed technological advantage (RTA); the width of each bar on the vertical axis reflects the number of patents in each category. RTA is defined as the share of UK's patents in a particular technology field relative to the global share of patents in that field. Analysis based on PATSTAT over 2005-2014.
SOURCE: R Martin et al., Innovation for a strong and sustainable recovery, LSE CEP, December 2020.

Further analyses considering innovation spillovers have shown that economic returns to investments in R&D in ocean and wind technologies in the UK are also high. Moreover,

54 R Martin et al., Innovation for a strong and sustainable recovery, LSE CEP, December 2020.

given regional patterns to such patenting, support for such technologies could play a role in addressing regional disparities.[55]

Another approach for analysing areas of comparative strength uses data on traded goods. Recent work at the LSE has considered a set of "net-zero-aligned" products by combining measures of product complexity (a measure that tends to be associated with technological sophistication) and a measure of "difficulty in transitioning" (this indicates how difficult it would be for a country to transition into a new product, given its relatedness to the products in which the country is currently competitive) to highlight where clean growth opportunities might lie in the UK and other core comparator countries.[56] The analysis finds that there are a number of technologically sophisticated green products that are relatively close to the UK's existing capabilities, and where the UK has comparative advantage internationally (mainly relating to power generation, carbon capture usage and storage, and hydrogen).

The patents and trade approaches outlined here have been also applied in a deeper analysis of the UK's capabilities in Carbon Capture Usage and Storage (CCUS) technologies. This is an area now seen as crucial for meeting net zero, and where the UK has a mix of comparative advantages which could be commercialised with a consistent institutional and regulatory framework in place.[57] However, analyses of patenting and traded goods is limited in its ability to capture growth opportunities in the service sector. Broader approaches that can account for innovation or comparative strengths in services, as well as process innovations that tend not to be patented (for example, classifying firms based on text on their websites)[58], are needed to generate new and timely metrics of net-zero-aligned economic activity that can be used to identify opportunities and evaluate policies.[59]

Identifying and building on innovative strengths – particularly in emerging areas, such as CCUS – are likely to bring growth benefits and employment opportunities over the medium run. But many net-zero aligned investments, CCUS included, are likely to generate jobs also in the short-term, often in the construction and installation of relevant infrastructure.[60,61] The places positively and negatively impacted by these changes will not always coincide. The evidence suggests that the extent to which local areas are likely

55 Interesting patterns are revealed in more granular analyses. While "clean cars" overall do not exhibit comparative advantage, the UK does exhibit comparative strengths in a number of technological sub-categories (for example, connected and autonomous vehicles). See: S Unsworth et al., Seizing sustainable growth opportunities from zero emission passenger vehicles in the UK, LSE CEP, February 2020.
56 S Unsworth et al., Jobs for a strong and sustainable recovery from Covid-19, LSE CEP, October 2020.
57 P Andres et al., Seizing sustainable growth opportunities from carbon capture usage and storage in the UK, LSE CEP, September 2021.
58 For details on such efforts by tech company "The Data City", see https://thedatacity.com/insight/first-list-of-uk-net-zero-companies/.
59 N Stern and A Valero, Innovation, growth and the transition to net-zero emissions, Research Policy, November 2021.
60 S Unsworth et al., Jobs for a strong and sustainable recovery from Covid-19, LSE CEP, October 2020.
61 P Andres et al., Seizing sustainable growth opportunities from carbon capture usage and storage in the UK, LSE CEP, September 2021.

to benefit from net-zero-aligned investments in employment and broader terms will depend on the pre-existing skills base[62], sectoral mix and other local endowments.[63]

For example, less affluent areas with a relatively high share of housing stock with the potential to improve efficiency through insulation measures are likely to have more demand for workers who can provide these, while also addressing fuel poverty and reducing cold-related illnesses particularly for the elderly in those areas. The extent to which environmental regulations might cause displacement will depend on the carbon intensity of specific sectors in specific places and the ease of transition of workers into other areas based on their skills and local demand. Hence, there will be varying impacts on employment across different people and places, and time frames which will need to be understood and actively managed.

As such, creativity in policy will also be required. This will include establishing long-term, coordinated industrial, innovation, climate, skills and broader policies that are coherent in light of the changed context and support a more sustainable and inclusive approach to growth. Key to this will be building in "predictable flexibility" so that investor, business and societal expectations are strong and stable enough to support investment and innovation, and also ensuring that learning about what works and updating is possible as part of the process of change. Finally, new approaches for the effective communication of change – and the benefits and costs it will bring – as well as participatory decision-making processes at the national and sub-national levels will all help ensure that transitions are understood and supported.

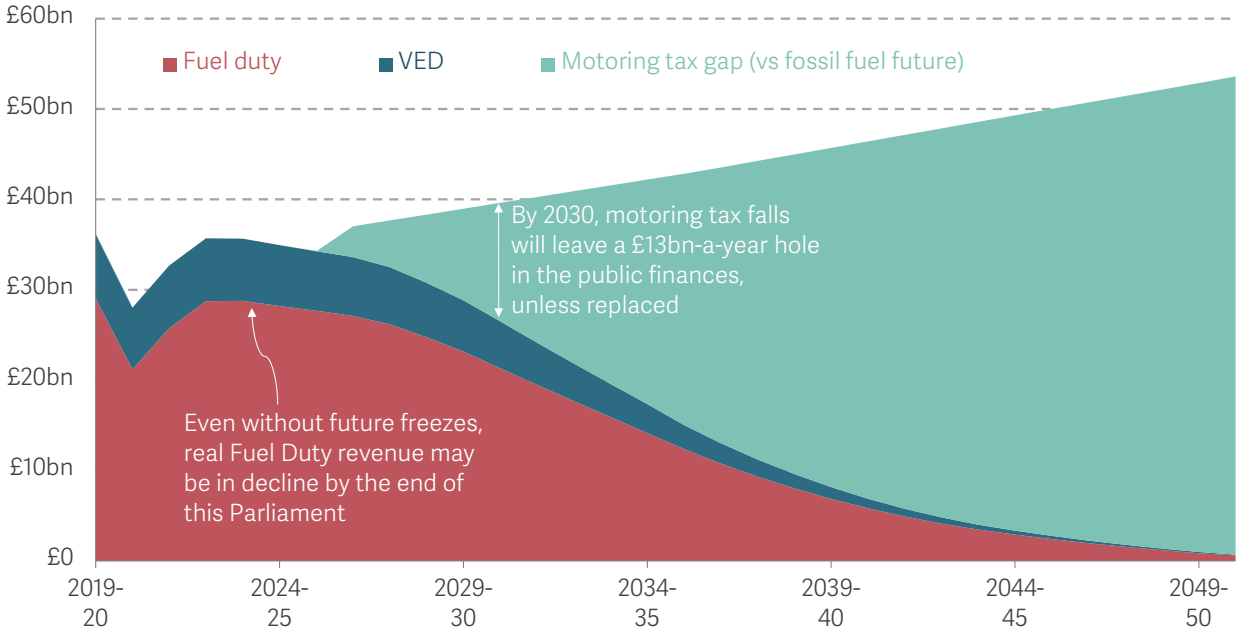
A changing tax base will alter the context within which fiscal decisions are made

Net zero increases the urgency of large and unavoidable fiscal decisions. Structural changes to the economy will have major impacts on the UK's tax base. Revenues from 'pollution taxes' such as fuel duty and vehicle excise duty are a major contributor to overall tax take, but will tend to zero as emissions fall.[64]

Projected falls in revenue from motoring taxes will not take the Government by surprise, but will soon accelerate.[65] Road tax revenues are forecast to start to decline by 2023-24, and by 2030-31 there will be a £13 billion hole in public finances, as Figure 16 shows. The scale of this fiscal risk means doing nothing is not an option, and adds a new backdrop for other significant tax and spending decisions.

62 D Popp et al., The employment impact of green fiscal push: evidence from the American Recovery Act, National Bureau of Economic Research, June 2020.
63 See: What works growth, accessed 10 September 2021.
64 OBR, Fiscal Risks Report, July 2021.
65 The market share of battery electric vehicles and plug-in hybrids increased from 8 per cent of car sales in January-July 2020 to 14.8 per cent one year on, with more pure electric cars now sold per month than diesel, Society of Motor Manufacturers and Traders data shows.

FIGURE 16: **Disappearing 'pollution tax' revenue is a major fiscal risk for the UK**
Projected Fuel Duty and Vehicle Excise Duty, and gap relative to maintaining revenue, real-terms (GDP-deflator adjusted): UK



NOTES: This forecast assumes that Fuel Duty rises each year from 2022, rather than being frozen
SOURCE: Analysis of OBR Fiscal risks report, July 2021

Prudent fiscal policy will see these lost tax revenues replaced with income from new or existing taxes, such as the implementation of road pricing for private cars and vans. Road pricing is an obvious option to account for a number of externalities of car use, such as congestion and pollution but is currently mired in complicated politics and tricky questions regarding its operation.[66] Failure to plug this tax gap will likely lead to enforced reductions in Government expenditure, or increased borrowing – both undesirable in the light of anticipated future pressure on state spending from health, social care and the response to the Covid-19 pandemic.

A changing tax base will likely see greater attention on carbon pricing

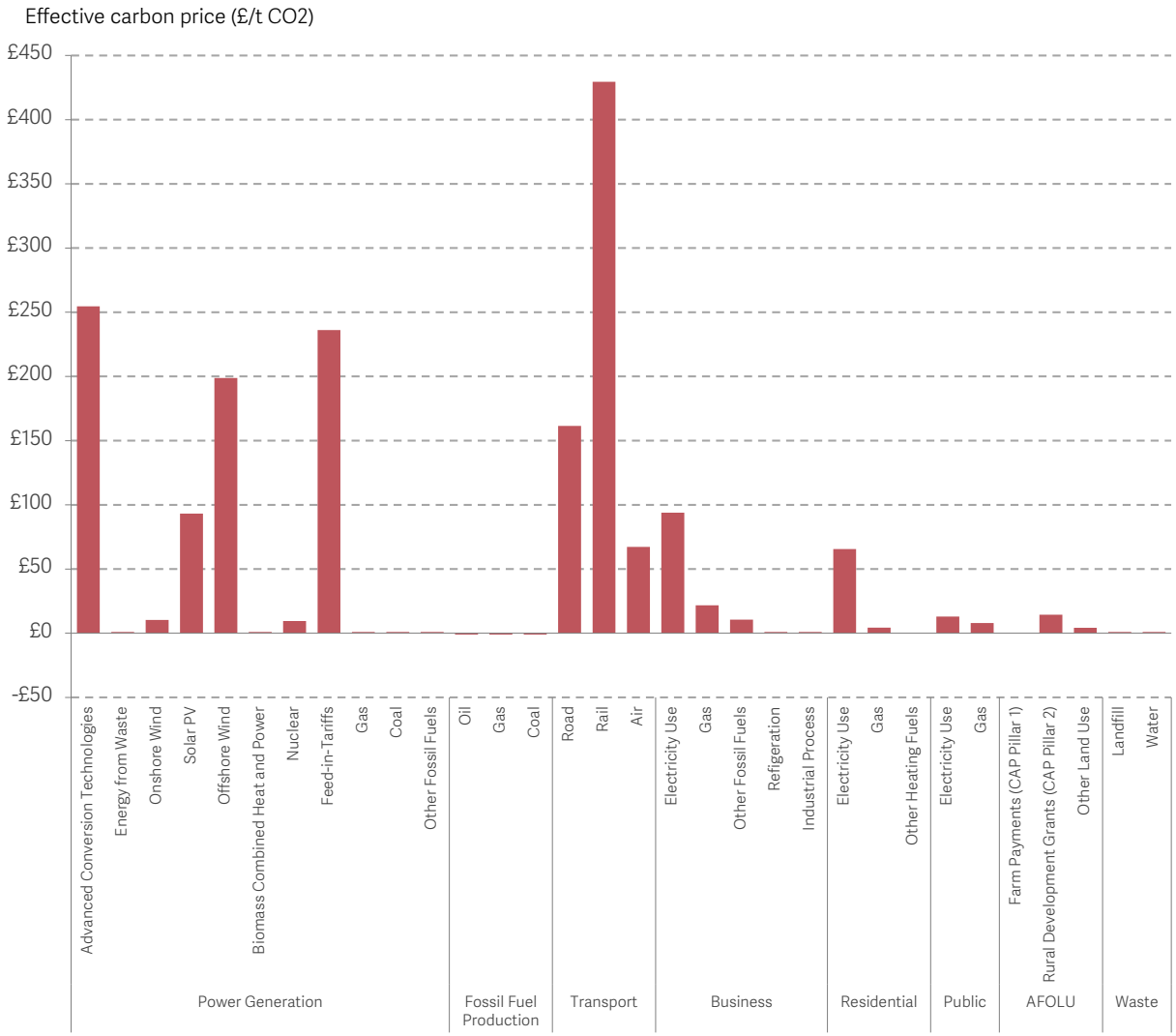
Putting a price on carbon is seen as a vital but under-used tool in reducing emissions. In theory, carbon pricing allows policy makers to avoid difficult decisions: all they have to do is put a price on carbon – either economy-wide or on a sector-by-sector basis – and they can then allow the market to decide the most cost-effective route to decarbonising.

Proponents of carbon pricing also point to it as a means of raising revenue, at least in the short and medium term, thereby offsetting lost income from faltering pollution taxes or as a means of raising revenue for low-carbon public investment. Over a longer timeframe, of course, policy makers must assume that carbon tax revenues will also tend to zero – there will be no (or very little) carbon emissions to price in a net zero world.

66 T Bell, A Corlett and D Tomlinson, To govern is to choose, Resolution Foundation, September 2021.

Whether as an explicit price or as a shadow price, carbon pricing is likely to be a necessary tool for reaching net zero, albeit one that is far from sufficient as a lone measure: regulation, standards, support for "clean" R&D are also necessary.[67] Currently, though, the range of carbon prices borne by different parts of the economy send mixed and wholly insufficient price signals, both to businesses and to people, as Figure 17 shows.

FIGURE 17: **The UK lacks a coherent and economy-wide plan on carbon pricing**
Effective carbon prices across the UK economy, 2018



NOTES: Effective carbon price borne by an emissions source resulting from direct pricing, subsidies, public expenditure, congestion charging and other Government interventions. First featured in 'Rethinking Decarbonisation Incentives' by the Energy Systems Catapult and Energy Technologies Institute, data shown is the average of ranges calculated by ESC.
SOURCE: Data provided by Energy Systems Catapult

67 https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices, accessed September 2021.

Lower carbon costs on aviation than on rail travel, or on domestic gas than lower carbon electricity all act to discourage the sort of choices we need individuals and firms to make.[68] Correcting these disparities is seen as a necessary and immediate step, but will change the costs of a large number of goods and services overnight, with a clear and material impact on large proportions of society.

But there are also drawbacks in the use of carbon pricing, such as economic shocks associated with their implementation, and with the inability to bind future governments to a trajectory that will provide a bankable signal to investors.[69] Underpinning multi-billion-pound investment decisions with a carbon price that can be changed with the flick of a pen is unlikely to assuage concerns from investors that the price will be altered at short notice, and this sort of uncertainty could ultimately lead to higher capital costs and a more expensive transition.

The exposure of households to carbon prices could also lead to a litany of unintended consequences, each potentially requiring additional policy and regulatory support.[70] The extent to which these corrective policies are needed may even undermine the notion of carbon pricing as a whole, instead requiring a comparable number of interventions to a decarbonisation strategy based on regulation and policy support.

Conclusion

Net zero brings both challenge and opportunity. It is a stretching target but one that is entirely achievable.

The next part of the UK's journey to net zero will take us from a period of setting targets to one with a focus on delivery, and this brings with it a need to assess and analyse policies that will see emissions from our cars and homes fall as quickly as those from our electricity system. It is vital to ensure that this transition does not burden the less well-off in society with extensive disruption or reductions in living standards. Breaking down aggregate, economy-wide cost-benefit analyses to account for distributional and temporal challenges is essential, as is acting to ensure that the benefits of moving to net zero – new industries, warmer homes, cleaner air – are accessible to all.

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68 G Day and D Sturge, Rethinking decarbonisation incentives: future carbon policy for clean growth, Energy Systems Catapult, July 2019

69 The UK's Carbon Price Support is a good example of how carbon pricing struggles to direct new investment. Introduced in 2013 to increase the value of emitting carbon beyond that imparted through the EU ETS scheme, it changed the economics of hydrocarbon-based electricity generation to favour gas over coal. A large amount of slack – gas power stations sitting idle or running well-below full capacity – allowed this transition to happen rapidly, but the Carbon Price Support has failed to incentivise any new generation capacity, which has instead been delivered through the Capacity Market, Renewable Obligation, or Contract for Difference schemes. The freezing of the Carbon Price Support at £18/tonne since 2016 also undermines the efficacy of carbon pricing – the ease at which a fundamental economic driver of new investment can be changed will result in higher financing costs and ultimately higher output costs.

70 J Stenning et al., Decarbonising European transport and heating fuels – Is the EU ETS the right tool? Cambridge Econometrics, June 2020.

Mainstreaming net zero into the UK's economic model is one way to achieve this, ensuring that all government interventions reinforce the move to carbon neutrality. Facing up to big fiscal decisions and strategic choices is also vital, ending the tradition of 'can kicking' in climate policy.

The Resolution Foundation's Economy 2030 Inquiry aims to help with this process. Only by rigorous analysis of the status quo and of the effects of new policies will the many upsides of Net Zero be captured, with any negative effects minimised. Following on from this launch report, as part of phase one of the inquiry, will be subsequent work on how net zero impacts on consumption, the implications for jobs and places, deep-dives on specific sectors or local areas, and how the UK can best identify areas of economic comparative advantage.

Phase two of the economy, taking place from late 2022, will build on these learnings, outlining a number of policies to shift consumption, how losers from the transition should be compensated, and how the UK economy can be best and most effectively moulded around the shift to carbon neutrality. The inquiry will also investigate the relationships between net zero and a number of other themes, such as Brexit and changing demographics, helping to remove climate policy from the silo in which it has been long contained and to making good on legal and moral obligations to decarbonise in a way that works for everyone.

THE ECONOMY 2030 INQUIRY

SHAPING A DECADE OF CHANGE

The UK is on the brink of a decade of huge economic change – from the Covid-19 recovery, to exiting the EU and transitioning towards a Net Zero future. The Economy 2030 Inquiry will examine this decisive decade for Britain, and set out a plan for how we can successfully navigate it.

The Inquiry is a collaboration between the Resolution Foundation and the Centre for Economic Performance at the London School of Economics. It is funded by the Nuffield Foundation.

For more information on The Economy 2030 Inquiry, visit economy2030.resolutionfoundation.org.

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