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CATAPULT Energy Systems

The future of UK carbon policy: how could the UK Emissions Trading Scheme evolve to help achieve net-zero?

Policy insight

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Contents

Summary

Headline points

- **Political realities and multiple market failures necessitate a balance between carbon pricing and complementary policies in the effort to reach net-zero.** While there remains a role for carbon markets and carbon pricing more broadly, in the heat and buildings, road transport, and greenhouse gas removals sectors, carbon pricing will need to be part of a package of complementary policies to address the challenges that are unique to each sector.
- **In devising the right policy package, it is crucial to understand the intended role of the UK Emissions Trading Scheme (ETS) in enabling decarbonisation in each sector.** This will dictate how the ETS works within an already complex policy landscape, including the placement of the compliance requirement in each sector's value chains.
- **The extension of carbon pricing to sectors not previously covered by the ETS must be underpinned by equity and fairness.** Introducing a carbon price on energy fuels would be particularly regressive in the absence of complementary measures to address challenges for low-income households.
- **Without careful design, expanding the UK ETS to as-yet uncovered sectors could risk undermining the efficacy of the scheme as a whole.** Price uncertainty [or volatility] from supply/demand imbalances or small illiquid markets, could result and inhibit investment and innovation, unless expansion is carefully designed, phased-in and integrated across sectors.

High-level recommendations

- **If the UK Government were to eventually expand the UK ETS to heat and buildings, this must be developed as part of a wider package of complementary policies that address specific challenges**, including fuel poverty and distributional impacts. For example, price collars could be used to prevent excessive price spikes, and the creation of a ringfenced fund (akin to the EU's Social Climate Fund) would reduce the impact of energy and fuel expenditure on vulnerable households. To support the improvement of low-carbon consumer propositions such as a market for heat pumps, the UK ETS compliance requirement could be the responsibility of energy suppliers.
- **The UK ETS requires wider system architecture changes to be able to incorporate greenhouse gas removal (GGR) techniques:** for example, expanding sectoral coverage to difficult emissions sources (which need GGR) or setting the cap to net-negative. While monitoring, reporting and verification of negative emissions remains a significant challenge, the proposed Carbon Regulator announced in the Government's *Net Zero Strategy* is a necessary pre-condition to ensure environmental integrity and additionality before the possible future inclusion of GGR in the UK ETS.
- **Including road transport within the UK ETS offers an opportunity for policymakers to enact broader fiscal reform of transport taxes, including fuel duty.** This would be most effective if placed within a package of policies that encourages a move away from private internal combustion engine vehicles, including through the rapid deployment of charging infrastructure for electric vehicles as well as incentives for modal shifts into active travel and public transport.
- **Introducing well designed sector-specific markets, with eventual linking to the UK ETS, could be a pathway to an economy-wide UK ETS in the future.** Therefore, policy capacity in the near term should focus on delivering a complementary set of policy packages, building on sectoral strategies. This could be supported by the development of more sophisticated carbon market modelling and analysis tools.

Expanding the scope of the UK Emissions Trading Scheme

The UK Emissions Trading Scheme (UK ETS) is already a key policy for achieving the UK's net-zero target in a cost-effective way and will remain so. The scheme has the potential to provide the backbone of an enduring economy-wide framework towards net-zero if sectoral policies are implemented in ways that complement, or are consistent with, an overarching UK ETS.

The UK Government has committed to exploring the expansion of the UK ETS to the two-thirds of emissions not yet covered by the policy, in line with the promise to make the scheme an opportunity for more ambitious carbon policy in the longer term. This would significantly expand the application of the polluter pays principle. However, without compensatory policies, expansion may risk entrenching inequality given that energy costs constitute a higher share of expenditure for lower-income households who are less able to change their consumption behaviour in response to higher prices.

This report draws on discussions from a series of roundtables held with experts and key stakeholders in January 2022 which considered questions of design plus implications and risks were the UK ETS to be enlarged to include three further sectors. Considerations for the three sectors in question are summarised below.

Heat and buildings

The current policy landscape in the buildings sector tilts in favour of high-carbon heating options, resulting from a complex mix of government subsidy schemes and taxes across different levels and for different fuels.

Expanding the UK ETS to cover heat and buildings could help to level the playing field between electricity and natural gas prices. In the case of such an expansion, placing the compliance obligation upstream, at the point of supply, could help drive investment decisions towards low-carbon alternatives. However, low-carbon heating alternatives – such as heat pumps – are not yet an economically viable proposition for consumers, in terms of either upfront or running costs. This suggests that making improvements to relative prices will be helpful but insufficient on its own to drive uptake of low-carbon technologies on the scale required.

To build consumer confidence in a market for low-carbon heating, policies will also be needed to increase the workforce with the skills to install low-carbon heating systems and scale-up the supply chains required to manufacture and deliver the hardware.

Greenhouse gas removal (GGR) techniques

Given that different GGR techniques vary in their stage of commercial readiness, a variety of financial incentives are needed to overcome the high cost of capital for nascent technologies. In the near term, relatively low prices in the ETS by itself are unlikely to deliver GGR at the scale required to meet the net-zero target. The UK ETS is also currently not equipped to operationalise GGR. Its future inclusion in the ETS requires fundamental design considerations to be addressed such as how to allocate GGR permits given their limited initial availability, how to ensure environmental integrity and additionality of GGR permits, and how to mitigate the potential for moral hazard that may arise from marketisation. In the shorter term, demonstration-scale policies other than a UK ETS are needed to drive the development of expensive engineered removals.

Road transport

The policy landscape around the road transport sector is already complex and includes various high taxes. Here, the fuel duty should be given particular consideration. A potential expansion of the UK ETS to the road transport sector would overlap with fuel duty and experience similar political and societal opposition. The simultaneous running of the two schemes would

unnecessarily complicate the policy landscape. It could also result in double pricing and increase transport fuel costs further, potentially leading to consumer opposition.

Other policies, both already in place and planned, may have a stronger potential to drive decarbonisation in the road transport sector. These include the ban on sales of new petrol and diesel vehicles in the UK from 2030, zero-emission vehicle mandates (with targets for a percentage of new car and van sales to be zero-emission each year from 2024), emission performance standards, and clean air zones. Arguably, a focus on delivering and strengthening these policy measures at the same time as encouraging modal shifts in transport choices might be a better use of government time and resource than bringing road transport into the ETS in the near term.

Cross-cutting risks

A number of risks exist across the three sectors. In the context of the current debate over the rising cost of living, adverse distributional impacts are especially important. Making energy fuels subject to the UK ETS on its own would be a regressive policy. Lower-income households would also be less able to mitigate their exposure to the scheme through technology-switching, given the high upfront costs of low-carbon alternatives. Distributional impacts of GGR, on the other hand, would depend on the chosen funding mechanism and the sector(s) through which the cost is passed through to households.

In all three sectors, complementary measures would be required to mitigate the negative distributional impacts of a potential expansion of the UK ETS; these measures could be funded through revenue raised from the scheme itself.

Expanding coverage of the UK ETS to sectors not yet covered could risk undermining the overall efficacy of the scheme, especially in relation to the price uncertainty (or volatility) it would bring from supply/demand imbalances or small illiquid markets. If the overall price of carbon under the UK ETS falls, the scheme's ability to drive decarbonisation in the sectors already covered as well as in the wider economy would be undermined.

Conclusions

We argue that although carbon markets and carbon pricing more broadly should be at the core of a net-zero-compatible policy framework, the question of 'when' carbon pricing should be extended is critical. Given the lack of compelling consumer propositions and the potential for undesirable distributional impacts in the heat and buildings sector, the technological immaturity of GGR and the existing policy complexity in the transport sector, extending the UK ETS to these sectors is likely to be challenging in the near term unless due consideration is given to these barriers. Carbon pricing needs to be part of a broad package of fiscal reform that includes complementary policies to address the challenges that are unique to each sector.

1. Introduction

Purpose of this Policy Insight

This report provides insights to inform the UK Government's ongoing review on expanding the scope of the UK Emissions Trading Scheme (ETS). It focuses on three sectors that might fall within the scope of future policy changes:

- Heat and buildings
- Greenhouse gas removal (GGR) techniques
- Road transport

The report is informed by discussions at roundtables held in January 2022 that explored the expansion of the UK ETS with experts and key stakeholders from the sectors in question.[1]

Overview of the UK Emissions Trading Scheme

The UK ETS is a key policy for achieving the UK's target of reaching net-zero emissions by 2050. It entered into operation on 1 January 2021, following the UK's departure from the European Union's Emissions Trading Scheme (EU ETS).

The UK ETS covers electricity generation, heavy industry and domestic aviation. Under the 'cap and trade' principle, an upper limit of emissions – the cap – is set for all participating installations. Allowances for emissions within the system are auctioned off or allocated for free. Trading of allowances between parties can occur if an installation exceeds or outperforms its limit, revealing a market price for carbon across covered sectors. Installations, as a result, can in theory achieve emissions reductions in the most cost-effective way.

From the outset, the UK ETS was established with the promise of providing an opportunity for more ambitious carbon policy in the longer term. While the initial UK ETS arrangements largely mirror those of the EU ETS, the cap was reduced by 5% of what would have been the UK's notional share had the country remained in the EU.

The UK Government has promised to review the system to consider aligning the emissions cap with net-zero and expanding coverage to the two-thirds of emissions not yet covered by the UK ETS. Since we hosted the roundtables, the Government has begun this process by publishing a consultation on *Developing the UK Emissions Trading Scheme*. This is further reflected in other recent Government publications, including the *Energy White Paper*, *Heat and Buildings Strategy*, and *Net Zero Strategy*, which all point to driving forward the use of the UK ETS to achieve net-zero. Although the *Developing the UK Emissions Trading Scheme* consultation does not seek explicit views on whether the current scope should expand to the heat and buildings or transport sectors, for the Government to be consistent with its intention, it may consider these sectors in the future. Moreover, the Government has stated that it is open to the possibility of linking the UK ETS internationally, in particular with the EU, which is moving forward with a carbon market to cover these sectors. As such, the UK may consider following suit on similar timelines to avoid significant divergence with the EU's core design features, which could make linking negotiations

[1] The [virtual] roundtables were co-hosted by the Grantham Research Institute on Climate Change and the Environment and Energy Systems Catapult (ESC) on 27 January. In this report, ideas and comments have not been attributed to any individual or organisation. A full list of participants can be found in Appendix B.

with the EU more complex. Delays in reaching a linking agreement can result in costly restricted linking arrangements (Quémin and de Perthuis, 2018) or even preclude an agreement altogether.

The Government has also rightly noted the need to "develop policies which actively support and encourage sectors to decarbonise, rather than rely on applying an emissions cap and the consequent carbon pricing as our sole mechanism" (Department for Business, Energy and Industrial Strategy [BEIS], 2021). Consequently, there is increasing policy pressure to clarify the future role of the UK ETS (for example, to discern whether the sectoral scope will be expanded to include all key emitting sectors).

Although current price spikes and the cost-of-living crisis may delay announcements, there is still considerable political will for net-zero and action to be taken on expanding carbon policy in the UK. However, there remains considerable work to do on policy design before delivery.

The role of sectoral policies and carbon markets for net-zero

In a market economy like the UK, policies that reward or require the reduction of emissions will be vital in channelling the investment and stimulating the innovation needed to achieve net-zero.

A mix of sector-specific carbon and complementary policies (as part of wider policy packages) within an enduring economy-wide framework is likely to be more socially *and* politically acceptable than a single, economy-wide carbon tax as a route to net-zero. Ensuring that the design of emissions reduction policies takes into account sectoral sensitivities means the same outcome – cutting carbon – can be achieved across all sectors, while providing greater confidence to those businesses developing innovative goods and services.

Sectoral policies can also be designed to align with principles of technology neutrality, whereby the Government does not favour specific low-carbon solutions, and of the long-term credibility of policy design. In the medium and long term, trading mechanisms and validated carbon credits can link across sectoral policies or obligations, providing a pathway to an enduring economy-wide framework. Indeed, this could help to establish a carbon price, and a wider carbon market for validated carbon credits that would apply to all major emitting sectors.

This approach has several key advantages for achieving net-zero:

- *Trading* provides flexibility in compliance strategies to emitters in different sectors, and enables a cost-effective and efficient balance of emissions reduction across sectors to emerge over time, including the development of negative emissions technologies.
- *Linked carbon markets* will place a more coherent value on emissions reduction across the economy, ensuring better optimisation of the use of low- and zero-carbon energy vectors – such as biomass and hydrogen – across different sectors.

The aim of linking sectors is to enable cost-effective emissions reductions that would result from flexible trading. It can also prevent the emergence of major differences in effective carbon prices that could distort investment choices across sectoral boundaries.

Sectors can begin to link as soon as the associated carbon markets allow, but this requires carbon policy design to consider linkages from their inception. In this way, sectoral carbon policies can remain tailored to the associated challenges and opportunities that arise within each.

The UK ETS could provide the backbone of this new framework. Sectoral policies can be implemented in ways that complement, or are consistent with, an overarching UK ETS. There is potential to place sectoral policies within the 'cap' of an ETS and for them to be linked by allowing the trading of carbon credits across sectors. In this sense, sectoral carbon policies can be seen as modules that can be linked over time so that they create and impose an economy-wide 'cap' on all emissions. Initially, trading may take place within sectors, with links introduced progressively across sectors as circumstances allow.

2. Expanding the UK ETS to heat and buildings

Currently, the heat and buildings sector is characterised by a low and uneven set of carbon prices that flow through to consumers. Relative prices are continuing to mean that higher carbon technologies, such as gas boilers, are the cheapest consumer option. In fact, nowhere is this more apparent than in this sector, where policy costs are loaded onto electricity prices, resulting in a significant cost differential relative to natural gas use.

Expansion of the UK ETS to the heat and buildings sector could level this playing field, given that electricity generation is already covered by the carbon market.

Compliance placement

Where the UK ETS compliance is placed is a critically important design choice for ensuring efficient policy implementation. For the heat and buildings sector, this could be at various points throughout the supply chain, either at the point of supply (upstream) or at the point of emission/consumption (downstream).

Arguments in favour of the placement being downstream (i.e. directly with consumers) highlight the advantages of exposing consumers to the full price, which can best induce behaviour change. However, the likelihood that households and small businesses will actively participate in a complex carbon market is extremely small and this is not a popular option, as a result.[2] That said, there are options to deal with such a barrier. For example, suppliers could be obliged to manage the compliance on behalf of consumers. Conceptually, this would be similar to the way in which aggregators operate in demand-side-response markets. This design choice comes with potential associated legality issues (e.g. suppliers might act in favour of their consumers), but it could incentivise behaviour change without requiring all energy users to participate directly in carbon markets.

A more appropriate solution could be to place the compliance mechanism further upstream.[3] Arguments in favour of this approach suggest that direct upstream exposure to the carbon price can also drive investment decisions towards low-carbon alternatives. For example, it can incentivise the creation of additional commercial opportunities for managing risks, hedging, and technological innovation. Even if it is placed upstream, a degree of cost pass-through is desirable so that companies and investors can recover parts of their incremental investment costs by achieving a higher sales price for lower carbon products.

While an upstream compliance mechanism would result in a less explicit price signal faced by consumers (even in the case of full cost pass-through), there are political economy advantages from shielding consumers from the full economic costs of the policy. However, every effort should be made to provide clear information, as communicating the impacts of a carbon price will help to increase its acceptance and address voters' concerns (Carratini et al., 2017).

The precise position of compliance in the supply chain is less obvious, however. There are strong arguments for it to be placed with energy suppliers, which directly interact with consumers and already manage the Climate Change Levy (CCL) for businesses. However, this would have political ramifications if it were designed to appear like another levy on consumers' bills, which would risk reducing support for carbon policy more generally.

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[2] In the roundtable this option was quickly dismissed.

[3] There was broad consensus on placing compliance upstream but not on the precise position – although placing it with energy suppliers was a popular option.

Alternatively, placement further upstream at the gas distribution level remains a feasible option. This is how it is applied in other emissions trading systems, such as California's and New Zealand's, but it raises potential issues around double counting and the overall impact the policy has on investment decisions. Double counting comes into question because gas electricity generators are already covered by the UK ETS. In Germany's new national emissions trading system (the *Nationales Emissionshandelssystem*, or nEHS), which sits separately from the EU ETS and covers both transport and buildings, provisions have been made to avoid double counting for installations already covered by the EU ETS. Distributors are allowed to reduce the amount of emissions they report, provided that sufficient evidence can be presented, through two methods: they can lessen their allowance surrender obligation by the equivalent amount of fuel volumes delivered to and used in EU ETS installations; or the operator of an EU ETS installation can apply for compensation for the additional pricing within the nEHS (DEHSt, 2021).

Timing

Given the current gas price spike and the nascent supply chain for low-carbon heating solutions, it seems clear that the UK ETS's expansion will need to be phased in gradually. Sequencing policies, starting with incentives rather than punitive measures, and including protection for households – such as recycling revenue back to affected households or by using portfolio standards – is crucial to ensuring fairness. If this does not happen, early, wealthier adopters of heat pumps will continue to be favoured and fuel poverty could be exacerbated.

There are other policy levers that would also need to be prioritised alongside the implementation of a carbon price through the UK ETS, such as supporting technological innovation and the development of new business models and consumer propositions.[4] The argument for this is that building a low-carbon heating market when the price incentives are insufficient will only delay long-term market creation. In this context, carbon pricing could act as a market enabler, accelerating business model innovation and, eventually, the formulation of better consumer propositions. This suggests implementation sooner rather than later would be advantageous.

This discussion highlights the wider uncertainty about how to decarbonise the heat and buildings sector and the precise role that the UK ETS could play in this.

Lack of a consumer proposition

For carbon policy to function as desired, not only must it incentivise consumers to switch to low-carbon alternatives, but the alternatives must exist in the first place. Research by Public First (2020) suggests households are not willing to be burdened with charges they cannot escape. For the heat and buildings sector, low-carbon alternatives such as heat pumps are not yet an economically viable proposition for most households, in terms of either upfront or running costs – although in light of current gas prices being at historic highs, the running costs for the most efficient heat pumps are likely to become cheaper than gas boilers for a wider range of properties and circumstances this year if gas prices continue to rise as expected. Mass market adoption will only happen when switching to a heat pump saves consumers money in the long run.

The view that low-carbon heating will be taken up by the mass market in the future is contingent on the ability to align policy frameworks today. Ensuring electricity and natural gas prices are on a level playing field is an obvious starting point. While the Government has suggested it will address this issue, to date there has been little movement in this regard.

[4] Many in the roundtable thought that this should be the case.

Barriers to mass market adoption are not limited to operational costs. High capital costs for consumers – in particular for heat pumps – are a significant near-term challenge. As a result of the long-term policy framework not being clear, the skills needed to install low-carbon heating systems and the supply chains required to manufacture and deliver the hardware do not have the incentive to mature sufficiently. This suggests that while improvements in relative prices will be helpful, that will not alone be sufficient to increase uptake of low-carbon heating options.

Carbon pricing in particular is often seen as a technocratic solution when in fact the challenge is acutely political. As described above, the current policy landscape tilts in favour of the high-carbon heating option, as a result of a complex mix of government subsidy schemes and taxes across different levels and for different fuels. Expanding the UK ETS to cover heat and buildings could help to reduce the competitive advantage currently held by high-carbon options. However, unless accompanied by reforms to simplify subsidy schemes and taxes in the sector, it would risk adding complexity and meeting opposition.

Distributional impacts across society

Regardless of where the UK ETS is implemented in the sector's supply chain, passing on costs via heating bills will prove regressive unless there are complementary policies to mitigate negative distributional impacts. For example, the EU has created a Social Climate Fund to address social impacts that may arise from expanding the EU ETS to the heat and buildings and transport sectors. The UK could follow the EU's example and establish a ringfenced fund to relieve pressure on vulnerable households arising from their increased expenditure on energy and fuel. Revenue recycling – from the fund – should at least in part pre-empt and cover any increases in energy bills arising from the carbon price. This is necessary to avoid any transitionary periods where high carbon taxes increase energy bills before energy efficiency improvements are implemented. Without such measures, there is a real risk that expanding the UK ETS – as with all decarbonisation policies targeted at domestic energy users – further exacerbates fuel poverty.

The likelihood of there being negative impacts that disproportionately impact lower-income households is further compounded by the lack of a compelling consumer proposition. This means that consumers are not currently able to escape price increases on natural gas by switching to alternative, low-carbon heating options.

The challenge of reducing emissions from heating is already a particularly politically charged issue; any impacts of policies designed to do this that are felt adversely by low-income households will continue to delay the decarbonisation of heat and buildings. Innovative new approaches may be necessary, to target interventions efficiently on those households most in need. For example, more ubiquitous and open energy data could be used as a basis for targeting assistance with energy bills and costs of the net-zero transition more smartly at those who need it (ESC, 2021a).

Price uncertainty

A frequent criticism of emissions trading schemes is the lack of price certainty. By design, an ETS offers clear outcomes and certainty that emissions will be reduced, leaving the market to determine the carbon price. Because of this, it is unclear how confident investors could be in the UK ETS. Despite UK ETS prices currently being high, the prices are volatile and divorced from market fundamentals (i.e. they reflect gas prices, rather than the fundamental decarbonisation strategy). Excessive price volatility in cap-and-trade systems can discourage capital investments, which may undermine political support and reduce investments in cleaner technologies. This is critical because if covered entities begin to question the expected trajectories within the UK ETS, it may undermine investment decisions that are needed now.

Carbon taxes could play a role instead, given that – in the absence of political interference – price certainty is provided in the long term. However, carbon taxes are also vulnerable to change for

political reasons and may offer less certainty than the ETS in terms of a long-term price signal (Rabe, 2018). Indeed, the UK's experience to date suggests that the application of carbon taxes does not yield the desired certainty in terms of a clear rising trajectory. For example, the fact that the Treasury has not provided a price escalator on the Carbon Price Support (CPS) has made it more difficult to predict than the EU ETS, which is at least based on what is happening in the markets.[5]

In the UK, a long-term increasing carbon tax, rather than a tightening cap, may be politically infeasible, as challenges with the Fuel Duty Escalator and the CPS demonstrate. Fuel duty has been 'frozen' since 2011,[6] which reflects the difficulty created by a steadily rising carbon tax when it hits voters in the pocket; the matter of heating is as politically charged as personal transport.

However, as long as the carbon price is high enough to level the playing field between low- and high-carbon energy sources, it is possible that there would be no requirement for an increasing price and other policies could make progress on reducing capital costs.

Finally, what appears to be a dichotomous choice between two distinct instruments can turn out to be a choice of specific design elements along a policy continuum (Stavins, 2022). If price certainty is the goal, there are design choices that can be made, even with an ETS. A price collar that combines an auction floor price with price triggers could be included in the UK ETS to provide enhanced price stability. The price collar could also be used to prevent price spikes, which would put further inflationary pressure on household bills. Within the EU, similar discussions are being held as prices have either been so low that nothing happens or so high that participants lobby for intervention.

Interaction with other policies

Carbon policy, such as carbon pricing, works best when supported by complementary policies. The salience of carbon pricing within this suite of policies varies from sector to sector (Burke, 2019; ESC, 2020a) and for heat and buildings, regulatory policy levers have higher salience. A carbon market on its own will therefore be insufficient. In the near term, greater impacts can be brought about by regulations, such as a ban on new gas boilers and other policies such as mandates and decarbonisation obligations. There remains, however, a role for a carbon market. Aligning relative prices with such regulations can help accelerate decarbonisation as part of a sector-wide approach that addresses all the challenges faced (i.e. access to finance, fuel poverty, deploying the supply chain, energy efficiency and insulation, the skills agenda, and so on).

Crucially, it is fundamental that heat and buildings policies are joined up. There is potentially a complex web of policies incoming to reduce emissions: bans on certain technologies, policy levies, obligations on manufacturers, and performance ratings on homes. The sector is at risk of becoming a messy policy landscape that does not serve wider decarbonisation goals well, unless careful design considerations are made about how policies will interact with each other.

[5] This was a view echoed by roundtable participants.

[6] In the Chancellor's Spring Statement 2022 the fuel duty was cut by 5p/per litre as a temporary measure for 12 months.

3. Expanding the UK ETS to greenhouse gas removal (GGR) techniques

Most modelled pathways that achieve net-zero require a significant amount of greenhouse gas removal (GGR) (IPCC, 2018; ESC, 2020b). However, the precise amount depends on the pathway: whether a greater or lesser level of decarbonisation is made now will determine the quantity of removals that are required in the future. While the UK's GGR industry is developing quickly, it remains embryonic. For the UK to scale up removal over the next two decades, the development of policy frameworks and incentives for GGR will need to accelerate.

Different GGR techniques vary in their stage of commercial and technological readiness (direct air carbon capture and storage [DACCS] is especially immature, for example), necessitating different financial incentives (e.g. innovation policy) to overcome the high cost of capital for nascent technologies. The types of policy levers under consideration are therefore likely to differ for engineered GGR versus nature-based GGR, but they could include:

1. *Enabling policies* (innovation support, infrastructure support, and accounting policies)
2. *Direct policies* (subsidies, taxes, cap and trade, and obligations)
3. *Integrating policies* (that maximise synergies between GGR policies and a broader policy landscape, including environmental policies [e.g. water quality standards], and aim to maximise the co-benefits under the Sustainable Development Goals, while reducing risks, such as impacts on water quality). (Vivid Economics, 2019)

Therefore, the expansion of the UK ETS is just one option available to policymakers.

Operationalising GGR

The anticipated availability of GGR ranges from 22 $MtCO_2$/year in 2035 to 58 $MtCO_2$/year in 2050 (CCC, 2021). For the marketisation of GGR to happen, a GGR permit must be generated for every tonne of CO_2 sequestered. Permits can then be traded between polluters or within carbon markets. Given the limited quantity of GGR permits – partly as a function of resource constraints – an important design question is how to allocate available GGR permits.

While land use constraints place an upper bound on the number of nature-based GGR permits that can be sourced domestically, there are further reasons to limit the availability of GGR, at least in the short term. The argument stems from the potential to create moral hazard and to deter mitigation efforts. While a certified, permanent GGR credit does not create moral hazard *per se*, reliance on future negative emissions does. Indeed, Anderson and Peters (2016) describe GGR as "moral hazard par excellence" owing to the risk of being locked into a high-temperature pathway if we rely on the prospect of GGR techniques but they are not then deployed, or if they do not remove emissions at the necessary scale. Moreover, opening up a carbon market for potentially lower-cost GGR (such as nature-based solutions) too early could exert downward pressure on the overall market-based price of carbon, in the absence of adjustments to emissions caps or other safeguards.

When considering how to allocate a constrained amount of GGR, should policymakers limit access to GGR permits only to hard-to-abate sectors or should they be integrated into and freely traded between carbon market participants? One possibility would be to impose sectoral limits on the use or allocation of quantitatively restricted GGR only to trade-exposed sectors or for activities associated with high residual emissions (Rickels et al., 2021). In answering this question, it is important to remember that most residual emissions in 2035 and 2050 are expected to be in sectors that are not currently covered by the UK ETS, such as international aviation and land use.

Unless the scope of the UK ETS is expanded to cover these sectors or the cap is set to net-negative, it may not be useful to include GGR permits in an ETS.

One alternative approach under the current sectoral coverage would be to make the cap within a UK ETS net-negative. For example, the EU Commission is looking to make the EU ETS net-negative by 2050. This is one way to design an ETS that is compatible with net-zero and the integration of GGR techniques. Moreover, the availability could be managed by having a clear set of parameters that need to be achieved – such as a balance between supply and demand or permit quality – before technological removals can be integrated. This is done, for example, in North America under the Low Carbon Fuel Standard (Global CCS Institute, 2019) and could be replicated in a UK ETS as part of a wider enabling policy framework in the short term.

Environmental integrity

A frequent criticism of GGR surrounds the environmental integrity of GGR permits, particularly if nature-based credits are generated from jurisdictions with a less than robust history of land use governance.[7]

The majority of the UK's GGR will be sourced domestically, and existing land use governance and standards are stronger in the UK than in some other locations. For example, afforestation is considered a permanent change of land use under law and is part of the UK's greenhouse gas inventory. Although it is often hard to empirically quantify emissions from land use change, independent monitoring, reporting and verification (MRV) of emissions takes place for UK-validated projects through the Woodland Carbon Code. Credibility in the MRV process is crucial to bring market confidence in the quality of GGR as well as a necessary precursor to any future inclusion in carbon markets.

The development of the Woodland Carbon Code offers a potential route through which to expand accreditation of nature-based solutions to include engineered removals. If this were twinned with a robust third-party credit rating, it could pave the way for an easier route towards including GGR in the ETS.

Despite the long-term storage of emissions using engineered solutions being viewed as robust, a precautionary approach is warranted and a regulator is still necessary. This is particularly the case given that methane leaks from gas pipelines have historically been underestimated, for example. There is a clear role for a regulatory body to set or inform accounting standards, supported by scientific backing.[8]

Including nature-based GGR techniques in the ETS may not drive the right actions in the right place, either. While inclusion of afforestation in the New Zealand ETS has driven afforestation, trees have not always been planted in optimal places or have conflicted with other land use priorities such as food production or emissions abatement opportunities. Therefore, careful consideration of the wider policy implications is required. Without a clear framework for ensuring that land use decisions are socially beneficial and take account of other societal benefits (e.g. ecosystem services and amenity), there is a risk of deploying solutions that do not deliver towards achieving net-zero and that exacerbate ecological and food security risks.

The role of a Carbon Regulator

Introducing strict regulation, for example, in the form of a Carbon MRV and Accounting Regulator (ESC, 2021c), would be essential to ensure GGR credits are truly additional, providing the

[7] This criticism was echoed by participants in the roundtable.

[8] There was broad consensus on this from participants.

necessary confidence that the removal is permanent, and ensuring MRV is consistent across projects and different GGR techniques. The Government's commitment, articulated in the *Net Zero Strategy*, to exploring options for regulatory oversight to provide robust MRV of GGR could play an important role in this. To manage issues of environmental integrity, the regulator could also choose to apply a ratio that is higher than a one-to-one relationship between GGR and generated credits. Under such a scenario, system-level risk could be hedged if, for example, for every tonne of CO_2 sequestered, two GGR permits were surrendered for compliance. This could create a buffer pool of permits, should any permits be reversed. Such a policy could simply be restricted based on the type of GGR, given that nature-based GGR is more likely than technology-based options to be prone to reversal.

In an alternative market structure with more government oversight, the regulator could act as a clearing point, buying available GGR through regular procurement rounds and releasing them into the ETS at the appropriate point. More broadly, and linked to how GGR permits are allocated, the regulator could commission a certain nature-based project, paying the operator for the action. The number of credits would then be guaranteed by the regulator, allocated to a sector, or banked.

Moral hazard

The assumption that marketisation is the optimal policy solution for GGR has the potential to create moral hazard. This is based on the assumption that to make markets work we need to make removals fungible with each other and with abatement. Research has highlighted that this increases the risk that excessive expectations of removal undermine nearer term investments in climate change mitigation, which are critical to limiting the future demand for GGR to a sustainable and practical level (Markusson et al., 2018). Whether market integration realises these risks depends on the size and cost of the GGR resource and when it might be available. In the short term it is unlikely there would be enough permanent, verifiable GGR to drive this risk, but in the medium to longer term, as technologies mature, this could become a very real risk.

The risk that this creates a 'dash for offsets' at the expense of necessary effort on emissions abatement would hugely undermine overall climate change mitigation efforts and as such it needs to be fully understood and managed. While there is a clear expectation that technological removals are not to be made *in place* of emissions reductions, the challenge for policymakers is to devise mechanisms that can reduce the mitigation deterrence risk while incentivising GGR. This could, for example, include separate targets for negative emissions and conventional abatement.

Distributional impacts

How the cost of funding GGR (and indeed all low-carbon policies) is distributed across society and how fair the policy is perceived to be will partly determine how enduring the policy framework will be over time. In the context of the current rise in cost-of-living, adverse distributional impacts are especially important to prevent. When considering the most appropriate policy mechanisms, analysis needs to be done to compare different funding mechanisms. This could, for example, compare a polluter pays approach – such as an ETS – with raising funds through a progressive means such as income tax.

While a market-based approach adheres to the polluter pays principle, this does not necessarily mean it will be progressive or fair, due to how and where those costs pass through to consumers. Whoever is buying the permits – whether it be industrial manufacturers, electricity generators or another – will pass costs onto consumers, including lower-income households. As the costs tend to represent a higher proportion of spend for low-income households compared with high-income households, the effect is therefore regressive. This is supported by modelling by the University of Leeds and the Grantham Research Institute which shows in a low GGR cost scenario for 2050, the lower-income households experience lower absolute impacts but higher relative impacts,

compared with high-income households. GGR costs make up over 0.54% of income for the lowest-income decile versus 0.19% for the highest-income decile (University of Leeds and GRI, 2021).

It is important to note, however, that the distributional impacts are somewhat tempered by the fact that under a polluter pays approach a large proportion of costs are likely to be passed through to the aviation sector. This tends to be more progressive as wealthier households fly more than lower-income households. Raising funds through general taxation may not be politically feasible but in distributional terms, it has the most progressive outcome (Owen et al., 2022, forthcoming).

How these concerns are managed also links back to who will be participating in the carbon market by 2030 and beyond. At this point there may be just a few major players left and the burden of cost may fall wholly on a small number of actors (e.g. aviation). While this intervention point could be progressive, for the reasons outlined above, it is important that the scope of carbon pricing is broad enough to cover entire supply chains. The impact on the wider economy also needs consideration. By focussing on a small number of polluters, they may face such high abatement or polluting costs that their businesses become unviable. Resulting in carbon leakage and job losses due to plant or business closures might be a lot more costly than allocating funds directly to GGR.

Alternative approaches to incentivising GGR

In addition to the moral hazard concerns that may arise from marketisation, there are other fundamental issues that need exploring. Policymakers must think about whether markets are the first tool we choose to incentivise removals – they come with political and economic presumptions and are rarely effective for goals that are not easily commodified or fungible. Markets do have the politically attractive option of minimising government intervention; for example, projects that are financeable with limited need for government investment at a time when public finances are constrained.

In the near term, relatively low prices in the ETS are also unlikely to deliver GGR at the scale required. It is very likely that additional mechanisms will be needed. In the shorter term, demonstration-scale policies other than the UK ETS are needed to drive expensive engineered removals. Research by the National Infrastructure Commission (2021) found that in the short term (through to the 2030s) direct government support is needed, for example via bespoke, technology-specific support.

One consideration around a non-market mechanism, at least in the short term and for technological removals, is that there is historical evidence of the power of public procurement in driving innovation and cost reduction. In this context, public procurement of emissions removals could serve as a genuine public good (ESC, 2021b). If the Government were to offset hard-to-abate government departments' emissions (e.g. those of the Ministry of Defence) with GGR credits, it could send a powerful signal to the market.

Revenue from carbon markets (in which GGR is not included) could be used to create a fund with revenue hypothecated to funding demonstration GGR technologies. This would be similar to Europe's innovation fund. Some of the revenue could also be reserved for managing political economy considerations such as undesirable distributional implications. However, policymakers must be mindful of the risk of allocating revenue several times over.

Regardless of the exact policy prescription, a clearer long-term policy approach is needed that recognises that the ETS is not a policy panacea that will create suitable amounts of GGR. As liquidity grows, integration into the ETS would become a more viable option.

4. Expanding the UK ETS to road transport

There is a clear pathway to decarbonising personal road transport, through the ban on the sale of new petrol and diesel (i.e. internal combustion engine/ICE) vehicles from 2030. The sector already benefits from low-carbon consumer propositions, with lifetime costs of electric vehicles (EVs) in some cases already lower than their fossil-fuelled equivalents. The inclusion of road transport in the UK ETS could be an additional incentive for technology/fuel switching. However, road transport in the UK is already subject to various high implicit carbon taxes (such as fuel duty) and policies that interact in complex ways. In such a policy landscape, the added value of using the UK ETS to drive decarbonisation in the sector requires interrogation.

Efficacy/salience of carbon pricing in the transport sector

The urgency to deliver a reduction in transport emissions requires changes in technology, infrastructure and travel behaviour. This necessitates a holistic policy package that may include extending the UK ETS to road transport. Although evidence suggests that carbon pricing can be an effective tool for reducing transport emissions (Andersson, 2017), support for including road transport in the UK ETS is low within the sector,[9] particularly for personal transport.

The policy package designed to reduce transport emissions should start from reducing avoidable fuel consumption by encouraging consumer behaviour change and modal shifts in transport choices, for example by prioritising investment in infrastructure to encourage active travel (walking and cycling) over road expansion. The potential inclusion of road transport within the UK ETS might not reduce fuel consumption, even among low-income households, who, perhaps surprisingly, do not significantly reduce the amount of fuel they buy in response to increasing fuel prices (Mattioli et al., 2018). However, it may cause them to compromise on other important areas of their household expenditure, which could exacerbate broader poverty concerns. While expansion could still encourage some technology-switching (from traditional ICE vehicles to EVs) or fuel-switching (from petrol/diesel to biofuels), this would possibly be limited in scale.[10] As the continued sale of large, fuel-inefficient vehicles around the world highlights, there are factors beyond fuel cost that affect consumers' vehicle purchasing decisions.

There are other policies, both already in place and planned, that may have a stronger potential to drive decarbonisation in the road transport sector. These include the ban on sales of new petrol and diesel vehicles in the UK from 2030, zero-emission vehicle mandates,[11] emission performance standards, and clean air zones. Arguably, a focus on delivering and strengthening these policy measures might be a better use of government time and resource than bringing road transport into the ETS in the near term.

Furthermore, a possible perverse 'rebound effect' could be created as a result of transport emissions being 'offset' elsewhere in the ETS, with the transport sector likely a net purchaser of emissions allowances. However, a declining cap would negate such an effect. This highlights a misconception that the UK ETS would enable 'emissions-free' transport and could lead to additional avoidable miles being driven.

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[9] As suggested by the representative sample of experts and industry stakeholders at the roundtable.

[10] This was raised as a potential limitation several times during the roundtable discussion.

[11] A zero-emission vehicle mandate was announced in the *Net Zero Strategy* to set targets for a percentage of manufacturers' new car and van sales to be zero-emission each year from 2024 (BEIS, 2021).

Interaction with other policies

Fuel duty represents a significant overlap with the potential inclusion of road transport in the UK ETS. While fuel duty was not introduced with an explicit objective to reduce emissions, it effectively serves this purpose by disincentivising the use of fossil fuels. The simultaneous running of the two schemes would unnecessarily complicate the policy landscape and could result in double pricing. Furthermore, if fuel duty were to remain, inclusion of road transport within the UK ETS would increase transport fuel costs further, potentially leading to consumer opposition.

In contrast, the Renewable Transport Fuel Obligation (RTFO) – a scheme explicitly aimed at driving the uptake of renewable and sustainable fuels – is an example of where the UK ETS could simplify the policy landscape. The RTFO – a highly complicated scheme in itself – also significantly overlaps with the ETS and a case could be made for removing it if road transport were to be included in the UK ETS.

Repurposing existing fuel duty to account explicitly for carbon could be another, simpler alternative to integrating road transport into the UK ETS. This could be complemented by further discounts for low- and zero-carbon vehicles under the Vehicle Excise Duty, extending the current approach.

Coverage of road transport in the UK ETS would experience similar challenges to those currently experienced by fuel duty. Political and societal pressures have been a barrier against proposals to raise fuel duty, which has been 'frozen' since 2011.[12] A carbon market may be more enduring in this regard, as the market drives the price. Fuel duty currently represents a significant source of government revenue, which will be eroded by decarbonisation. Including road transport in the UK ETS does not offer the desired replacement for fuel duty in this respect, as its scope to generate revenue would similarly decrease as decarbonisation ramps up via the electrification of road transport. Road pricing could be a viable alternative, which could internalise carbon emissions and also a range of other negative externalities, including air pollution and congestion, within the cost of driving. This is important as any intervention on transport fuel costs that is purely carbon-based could negatively impact air pollution by making diesel favourable over petrol, necessitating the presence of other policies such as Ultra Low Emission Zones. Given this context, extending the UK ETS to road transport must be part of a broader package of reform to motoring taxation.

Distributional impacts

The regressive nature of including road transport within the UK ETS is an area for concern.[13] Although the differential is less than in the heat and buildings sectors, transport costs typically represent a higher proportion of costs for lower-income households than for higher-income households. Lower-income households would also be less able to mitigate their exposure to the scheme through technology-switching, as EVs are not yet widely affordable and their second-hand market is immature. Furthermore, distributional impacts would be spatially imbalanced given inadequacies in rural public transport, the greater distances that need to be travelled in rural areas and unbalanced investment in charging infrastructure for EVs, which has been deployed primarily in urban areas. Unless the potential expansion of the ETS in this direction is compensated with progressive measures and this is made obvious to the public, the UK could have a similar experience to the *Gilets Jaunes* movement in France.

[12] As previously mentioned, a cut of 5p/litre was announced in the Spring Statement 2022, to be in place for 12 months.

[13] The extent of the regressive impacts would depend on whether a potential inclusion of road transport in the UK ETS is introduced in place of or in addition to the existing fuel duty. This is a question with wider considerations, as discussed above.

Use of revenue

If road transport were covered by the UK ETS, the revenue raised could be reinvested within the sector, with either a direct link to decarbonisation or to offset any regressive impacts.[14] Such investment could be directed towards a holistic decarbonisation effort, including accelerating the uptake of low-carbon vehicles, as well as supporting shifts to more sustainable modes of transport such as public transport and active travel. The uptake of EVs could be accelerated via further purchasing grants and a rapid expansion of charging infrastructure across the country. Furthermore, freezing fuel duty has led to the cost of driving to fall in real terms, which has created a perverse incentive to drive instead of using public transport.

Lifecycle emissions

Many of the UK's automotive manufacturers already have emissions reductions targets (SMMT, 2021). Nevertheless, any policy tool designed to incentivise the uptake of EVs needs to be complemented with an approach to address emissions embedded in the production of the vehicles. The inclusion of road transport in the UK ETS might not provide the appropriate scope for this, since the intervention would be made on the fuels rather than the vehicles themselves. While automotive manufacturers are already exposed to the UK ETS through their industrial emissions as well as their electricity usage, this is currently functioning as a compliance tool rather than as a genuine incentive to transform production processes.

Coverage of different transport modes

There is more support for including road freight in the UK ETS than for including personal transport. Arguments for including road freight firstly focus on the fact that such an intervention would be more likely to drive a switch to low-carbon vehicles because fleet operators need to consider the operating costs of an entire fleet at the time of purchase and might be more averse to the risk of technology lock-in. Secondly, if road transport were to be included in the UK ETS, it would be highly impractical to place the liability downstream at the consumer level. Freight transport may be less exposed to this limitation as freight is typically managed by hauliers, meaning there would be fewer players to regulate compared with passenger transport. Lastly, if international aviation and maritime transport were made subject to the UK ETS (or an equivalent policy) but road transport was not, this could cause a market distortion – assuming there were no other equivalent policies – across the different modes within freight.

[14] There was broad support for this in the roundtable.

5. Conclusions

Drawing on expert input from stakeholders from the heat and buildings, greenhouse gas removal and road transport sectors, this report has attempted to highlight important policy design considerations associated with extending the UK ETS to these respective sectors. We argue that although carbon markets and carbon pricing more broadly should be at the core of a net-zero-compatible policy framework, the question of 'when' carbon pricing should be extended is critical. Given the lack of compelling consumer propositions and the potential for undesirable distributional impacts in the heat and buildings sector, the technological immaturity of GGR and existing policy complexity in the transport sector, extending the UK ETS to these sectors is likely to be challenging in the near term unless due consideration is paid to these barriers. Carbon pricing will therefore need to be part of a wider package of complementary policies to address the challenges that are unique to each sector.

More broadly, expansion to uncovered sectors of the UK ETS could risk undermining the overall efficacy of the scheme. The current UK ETS has benefitted from being informed by the EU ETS's 15 years of experience,[15] and its development through a 'learning by doing' approach. Changing an established system carries risks, particularly in relation to the price uncertainty it would bring.

In the near term, implementing the expansion of sector coverage could lead to volatility in the price of carbon under the UK ETS (if supply and demand imbalances occur), threatening the scheme's ability to drive decarbonisation in the sectors already covered as well as in the wider economy. There are ways to safeguard the UK ETS, for example, by establishing new sectors as separate markets initially, before their eventual incorporation. This, of course, carries its own risks, because smaller sectoral markets could suffer from liquidity issues. In the near term, such an approach could also result in different sectors being exposed to significantly different carbon prices. This by itself would not necessarily be a step backwards for carbon policy, given the significantly different 'effective carbon prices'[16] currently experienced across sectors (illustrated in Appendix A). Indeed, establishing principles of convergence towards a near economy-wide framework through linking can enable the necessary long-term investments and behaviour change required.

High-level recommendations

- **If the UK Government were to eventually expand the UK ETS to heat and buildings, this must be developed as part of a wider package of complementary policies that address specific challenges**, including fuel poverty and distributional impacts. For example, price collars could be used to prevent excessive price spikes, and the creation of a ringfenced fund (akin to the EU's Social Climate Fund) would reduce the impact of energy and fuel expenditure on vulnerable households. To support the improvement of low-carbon consumer propositions such as a market for heat pumps, the UK ETS compliance requirement could be the responsibility of energy suppliers.
- **The UK ETS requires wider system architecture changes to be able to incorporate greenhouse gas removal (GGR) techniques:** for example, expanding sectoral coverage to difficult emissions sources (which need GGR) or setting the cap to net-negative. While monitoring, reporting and verification of negative emissions remains a significant challenge, the proposed Carbon Regulator announced in the Government's *Net Zero*

[15] In terms of sector expansion, the EU is currently considering similar changes to its ETS.

[16] An 'effective carbon price' is the incentive or reward for a firm or individual to reduce emissions (in £/tCO_2e) resulting from direct (e.g. explicit carbon pricing instruments, and energy and fuel taxation) and indirect (e.g. reduced VAT on energy, subsidies for low- and zero-carbon options) carbon policies.

Strategy should be used to ensure environmental integrity and additionality before the possible future inclusion of GGR in the UK ETS.

- **Including road transport within the UK ETS offers an opportunity for policymakers to enact broader fiscal reform of transport taxes, including fuel duty.** This would be most effective if placed within a package of policies that encourages a move away from private internal combustion engine vehicles, including through the rapid deployment of charging infrastructure for electric vehicles as well as incentives for modal shifts into active travel and public transport.
- **Introducing well designed sector-specific markets, with eventual linking to the UK ETS, could be a pathway to an economy-wide UK ETS in the future.** Therefore, policy capacity in the near term should focus on delivering a complementary set of policy packages, building on sectoral strategies. This could be supported by the development of more sophisticated carbon market modelling and analysis tools.

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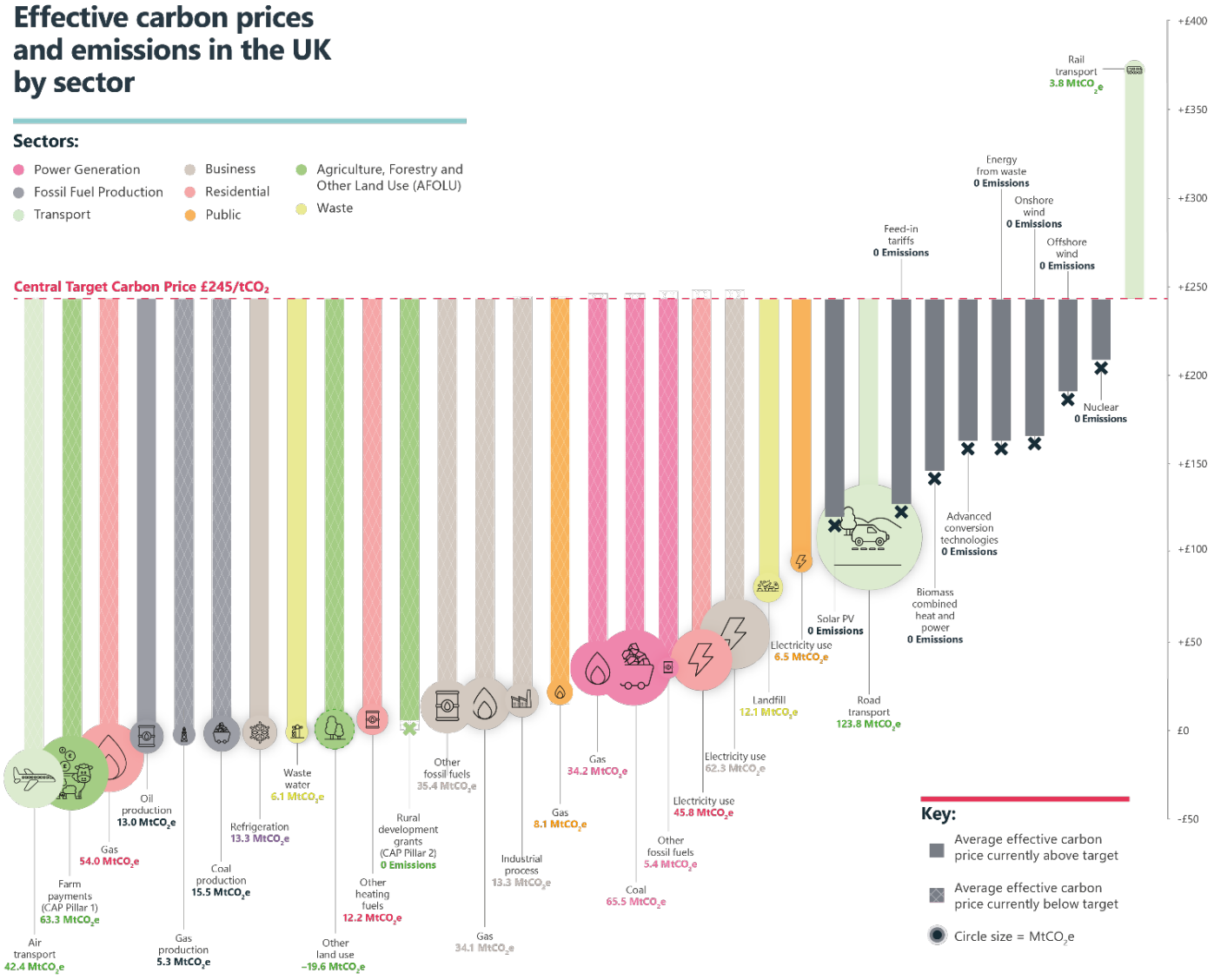
Appendix A: Effective carbon prices and emissions in the UK by sector



Note: The average target price of £245/tCO_2e is the central value for 2021, as used by BEIS for appraisal purposes.

Source: ESC (2018)

Appendix B: Participants at the sector roundtables

All the roundtables took place virtually on 27 January 2022.

Heat and buildings

Chair: Guy Newey, Energy Systems Catapult

Adam Bell, Stonehaven

Alex Chapman, New Economics Foundation

Bean Beanland, Heat Pump Federation

Bianca De Farias Letti, Climate Change Committee

Bridget Beals, KPMG LLP

Calum Boyd, HM Treasury

Caroline Bragg, Association for Decentralised Energy

David Ellen, BEIS

Ed Wingfield, BEIS

George Day, Energy Systems Catapult

Henry Dieudonne-Demaria, BEIS

Hywel Lloyd, Active Building Centre

Jeff House, Baxi

Joe Cooper, BEIS

Jonathan Marshall, Resolution Foundation

Malini Desai, BEIS

Megan Heap, Welsh Government

Michael Thompson, Climate Change Committee

Natalie Lee, BEIS

Richard Caldecourt, BEIS

Richard Lowes, RAP

Ross Loveridge, Scottish Government

Roz Bulleid, Green Alliance

Sam Hollister, OVO

Stuart Evans, Vivid Economics

Tim Lord, Phoenix Group

William Edrich, Sunamp

Zoe Larkin, BEIS

Greenhouse gas removal techniques

Chair: George Day, Energy Systems Catapult

Ajay Gambhir, Imperial College London

Andrew Baker, Scottish Forestry

Caterina Brandmayr, Green Alliance

Christoph Beuttler, Climeworks

Conor Hickey, University of Oxford

Dalia Majumder-Russell, CMS

Duncan McLaren, Lancaster Environment Centre

Helen Bray, Carbon Engineering

Henry Dieudonne-Demaria, BEIS

Jay Shah, BEIS

Joanna Campbell, National Infrastructure Commission

Joe Cooper, BEIS

Karl Smyth, Drax

Malini Desai, BEIS

Megan Heap, Welsh Government

Pat Snowdon, Scottish Forestry

Robbie Duggleby, BEIS

Simon Manley, The Future Forest Company

Stuart Evans, Vivid Economics

Ted Christie-Miller, BeZero Carbon

Tom Smiles, HM Treasury

Vivian Scott, Climate Change Committee

Wilfried Rickels, Kiel Institute

Yorukcan Erbay, Element Energy

Road transport

Chair: Sam Fankhauser, University of Oxford

Adam Chase, ERM

Alex Chapman, New Economics Foundation

Andy Eastlake, Zemo Partnership

Carolin Kleber, BEIS

Chris Ramsay-Collins, BEIS

Ed Birkett, Policy Exchange

Ed Wingfield, BEIS

Edoardo Lanfranchi, BEIS

Emily Worthing, BEIS

Eoin Devane, Climate Change Committee

Jakob Graichen, Oeko-Institut

Joe Cooper, BEIS

Lauren Pamma, Green Finance Institute

Malini Desai, BEIS

Matt Finch, T&E

Matthew Croucher, SMMT

Megan Heap, Welsh Government

Michael Tholen, OEUK

Natalie Lee, BEIS

Nick Shaw, Department for Transport

Phil Goodwin, Foundation for Integrated Transport

Rob Macquarie, Grantham Research Institute

Stuart Dossett, Green Alliance

Tom Smiles, HM Treasury

Zoe Larkin, BEIS