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Centre for Climate Change Economics and Policy

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Policy brief

How to price carbon to reach net-zero emissions in the UK

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Headline issues

- The UK government needs to reform its approach to carbon pricing if its new commitment to net-zero emissions by 2050 is to be credible.
- It is sensible to implement a politically feasible 'medium-level' carbon price that is higher than today's price.
- To ensure full decarbonisation, this carbon price must be complemented by regulation, technology support and incentives for negative emissions to remove residual CO_2 from the atmosphere.

Policy briefs provide analysis on topical issues, presenting specific recommendations to inform ongoing policy debates. Drawing on the Grantham Research Institute's expertise, they summarise either our research findings or the state of knowledge about a particular issue.

This policy brief has been written by **Joshua Burke, Rebecca Byrnes** and **Sam Fankhauser**.

Summary

- **The move to a net-zero emissions target will require a higher shadow price than the current projections from the Department for Business, Energy & Industrial Strategy (BEIS).** A shadow price that is target-consistent with net-zero would start at £50 (with a range of £40–100) per tonne of carbon dioxide (tCO_2) in 2020, rising to meet the cost of negative emissions technology at £160 (£125–300) by 2050, which will be needed for complete decarbonisation. This should be the Government's carbon price for internal policy guidance.
- **To be politically feasible, the carbon price imposed on emitters may have to be lower than the shadow price, and must be responsive to the sector context.** The revised carbon price could therefore be differentiated by sector. A politically feasible carbon price could start at around £40 per tCO_2 in 2020, rising to £125 per tCO_2 or more in 2050.
- **Negative emissions should be incentivised in sectors that can deliver them.** The Government could set up a public procurement scheme where it purchases offsets in proportion to the residual carbon output, or establish a market for offsets that market participants buy in place of paying the carbon price. Any approach to negative emissions must have the highest levels of environmental integrity.

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Accelerating climate action: the UK context

Across stakeholders and political parties in the UK consensus is growing on the need for greenhouse gas emissions to fall to 'net-zero'. This means balancing carbon emissions with carbon removal. Now the Government's independent advisory body, the Committee on Climate Change, has provided a compelling and comprehensive assessment of how the target can be met (CCC, 2019).

Reducing emissions to net-zero is in line with the latest evidence from the Intergovernmental Panel on Climate Change, which shows that to limit global temperature increase to 1.5°C – the most ambitious goal of the 2015 Paris Agreement – emissions will have to fall to net-zero globally by 2050 (IPCC, 2018).

Neither the UK's 2050 target under the 2008 Climate Change Act, nor its actual emissions performance, is consistent with achieving net-zero. However, strengthening the target is meaningless without a credible policy framework in place. This brief sets out the importance of pricing carbon as a key component of any strategy to reach net-zero.

Putting a higher price on carbon to achieve 'net-zero'

It will be very hard to achieve net-zero emissions in the UK without a proper price on carbon. Pricing carbon encourages emissions to be reduced where it is cheapest to do so, is easier to get right than regulation, and sends a clear signal that the polluter must pay.

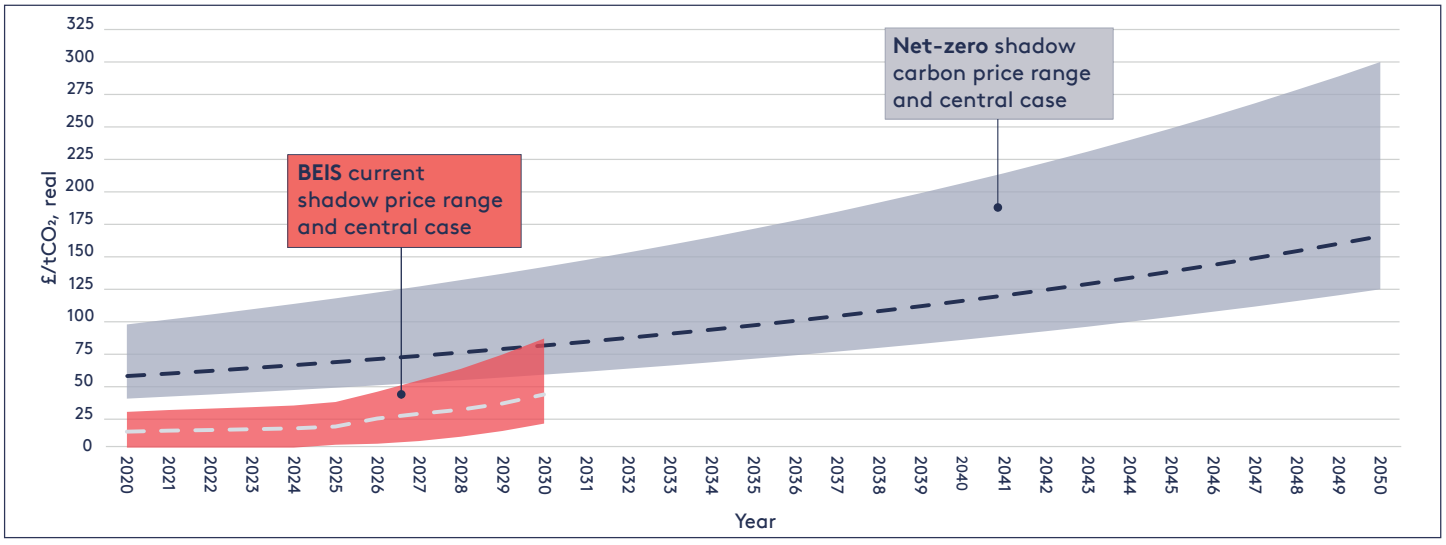
The cost of achieving net-zero at the margin will be higher than the cost of the UK's current target of reducing emissions by 80 per cent on 1990 levels by 2050 (see Fankhauser et al. [2018] for an overview of the UK's targets). This calls for higher carbon prices than those currently in place. Carbon has been under-priced in most sectors to date, stalling the development of low-carbon solutions, particularly in sectors that are more difficult to decarbonise.

Designing the right price

The Government will have to adjust the shadow price of carbon it uses internally to guide public-sector decisions. A shadow price that is consistent with net-zero would start at £50 (with a range of £40–100) per tonne of carbon dioxide (tCO_2)

Figure 1. BEIS short-term modelled values versus new net-zero shadow carbon price, 2020–50

Source: Department for Business, Energy & Industrial Strategy [BEIS] (2019) and authors' calculations



in 2020, reaching £160 (£125–300) per tCO_2 in 2050, which reflects the likely cost of negative emissions technology. This cost serves as the new anchor of the shadow price trajectory (see Figure 1).

It is doubtful that a carbon price at this level can be imposed on all emitters. A high carbon price results in a redistribution of incomes between low- and high-carbon producers, consumers and government that may stretch the political consensus. Political realities necessitate a balance between carbon pricing and complementary policies. We therefore call for a medium-level carbon price in the private sector that makes the polluter pay but may not lead to full decarbonisation. For most sectors, this price would start at around £40 per tCO_2 in 2020 (the lower end of the shadow price range) and would typically rise to around £100–125 per tCO_2 by 2050.

As we describe below and in Figure 2, there may be differences in price levels between sectors to account for differing contexts. The carbon price may rise more slowly in sectors where full decarbonisation is cheap, and be higher in sectors where remaining emissions would otherwise be too high.

The new pricing schemes can build on existing measures (such as the Climate Change Levy[1]), although this is also an opportunity to improve and simplify the policy landscape. Schemes will have to be designed carefully to ensure public buy-in. This includes targeting the recycling of carbon price revenues transparently and with sound communication.

If imposed through a tax or the auctioning of emissions allowances, the proposed price levels would raise public revenue of around £20bn a year until the early 2030s, before falling gradually as emissions decline to net-zero. This is equivalent to about two-thirds of the total revenue raised through fuel duty. If fully redistributed it would equate to a carbon dividend of about £300 per person per year.

To get to net-zero, remaining emissions will have to be treated through complementary policies (see Figure 2) or offset through negative emissions elsewhere (see Figure 3). A net-zero target will probably move the balance between carbon pricing and complementary policies in favour of the latter.

Carbon pricing by sector

Electric power

The UK has the institutional architecture to decarbonise the power sector, and the technologies exist to deliver a zero-emissions outcome. Plus the power sector may contribute to negative emissions through the deployment of 'bioenergy with carbon capture and storage' (BECCS).

A moderate carbon price starting at £40 per tCO_2 in 2020 rising to £120 per tCO_2 in 2050 (the anticipated cost of carbon capture and storage), complementing existing measures, should be sufficient to secure a net-zero power sector. This carbon price could be based on the existing carbon price floor[2] or a new scheme, depending on the UK's future participation in the EU emissions trading system.

By raising the price of gas, the carbon price will increase electricity prices. However, the impact on electricity bills should be small, since a higher carbon price will also reduce the payments that have to be made to clean energy producers under their 'Contracts for Difference'[3]. Complementary policies will also need to focus on ensuring high system flexibility in a highly intermittent energy network.

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Notes:

1. The Climate Change Levy is a tax applying to electricity, gas, solid fuel and liquefied gases used for lighting, heating and power in the business and public sectors.

2. The carbon price floor is the minimum carbon price UK power generators are required to pay. The Government recently decided to cap the carbon price floor at £18.08 per tonne of carbon dioxide-equivalent until 2021.

3. Contracts for Difference are the Government's main mechanism for supporting low-carbon electricity generation.

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Transport

The technologies to decarbonise road transport are increasingly being deployed and falling in cost. A carbon tax is an effective way to support these trends. Transport fuels are already heavily taxed for both revenue-raising and environmental reasons, and raising them has proven difficult in the past.

Nevertheless, the fuel duty accelerator should be reinstated to quicken the uptake of zero-emissions cars, incentivise fuel efficiency and discourage short journeys. The carbon price component of fuel duty could start at £40 per tCO_2 in 2020 rising to £100 per tCO_2 in 2050. Had the fuel duty escalator not been frozen, its level would already be aligned with this trajectory.

The uptake of zero-carbon vehicles could be further encouraged through an even stronger differentiation in vehicle excise duty and policy support for setting up a recharging infrastructure. These extra measures gain in importance the lower the political will to increase the price of transport fuels.

Aviation and shipping are hard-to-treat sectors that could have substantial demand for negative emissions. The carbon price on international transport fuels should therefore be aligned with the negative emissions price, starting at around £50 per tCO_2 in 2020 and rising to £160 per tCO_2 (the likely cost of negative emissions) by 2050. This price incentive may have to be complemented by regulatory measures such as increasingly stringent targets for synthetic fuels and internationally coordinated measures such as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Buildings

Progress in reducing emissions from buildings has been hampered by an insufficient and uneven carbon price, which discourages zero-carbon solutions. Domestic energy consumption, in particular of natural gas, needs to face a higher carbon price. This will create a level playing field with clean electricity.

A carbon price on its own will not be enough. Carbon pricing has to be complemented by regulation, including energy efficiency standards on appliances and building standards for new and refurbished homes. The roll-out of zero-carbon heating solutions may also need government support.

A carbon price on domestic energy use will be difficult politically and there are genuine fuel poverty concerns. Energy efficiency improvements can help to keep bills stable by reducing the amount of energy required. We propose a starting price of £40 per tCO_2 by 2020, rising to £100 per tCO_2 by 2050, when few emitters will still be paying the price.

Industry

The carbon price faced by industry must become broader and more uniform.

For non-energy-intensive industry, energy use is a relatively minor cost and a rising carbon price in the order of £40 per tCO_2 by 2020, rising to £100 by 2050 would ensure a zero-carbon outcome.

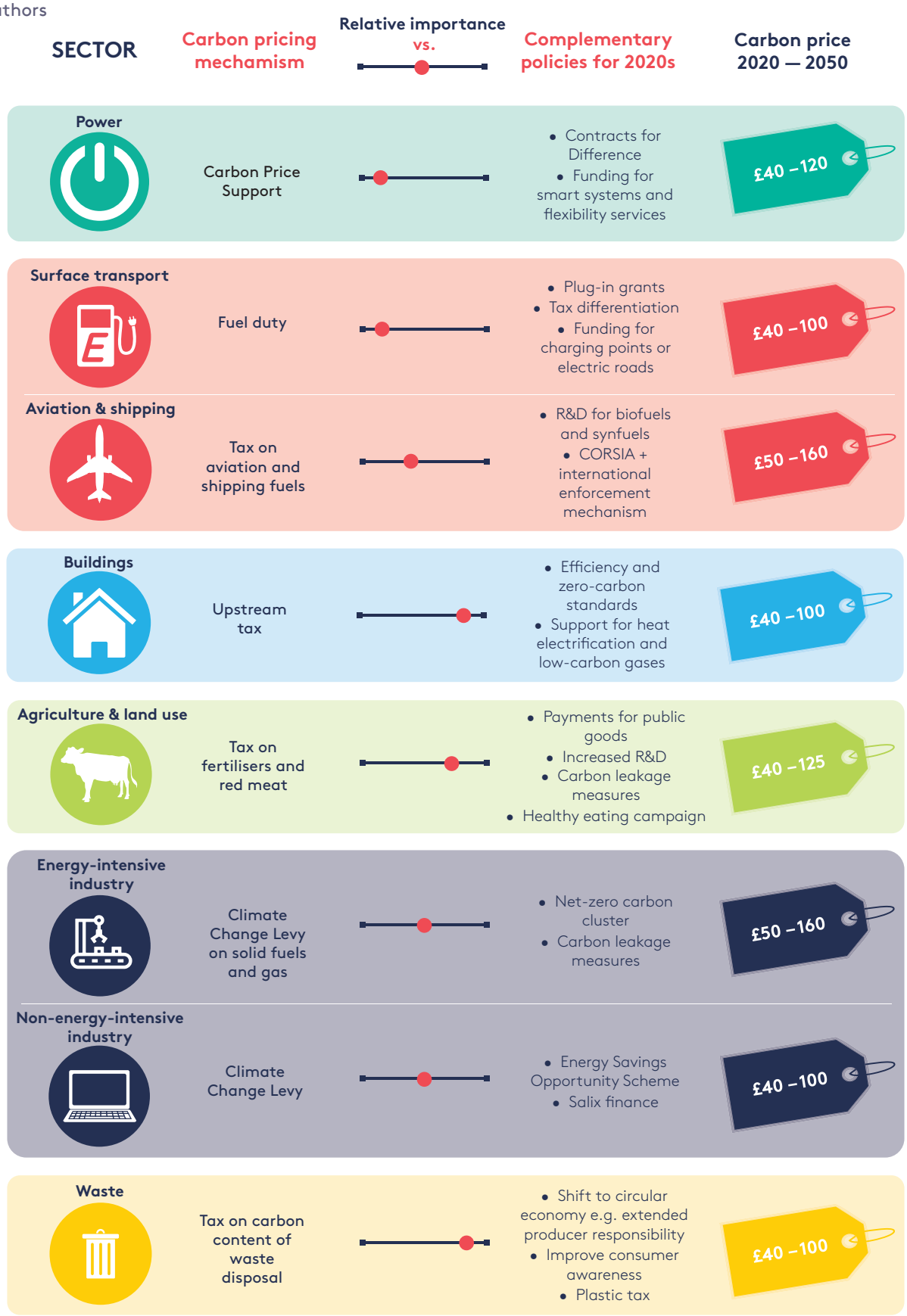
This carbon price could be levied by reforming the existing Climate Change Levy, raising its level and charging it according to the carbon content of fuels. Exemptions through Climate Change Agreements[4] should be phased out or made consistent with a net-zero target. There should be no further

Note:

4. Climate Change Agreements are voluntary agreements reached between UK industry and the Environment Agency to reduce energy use and carbon dioxide emissions. In return, operators receive a discount on the Climate Change Levy (see p3).

Figure 2. Differentiated carbon prices and the relative importance of carbon pricing versus complementary policies by sector

Source: Authors



"Policy interventions in agriculture and land use need to be holistic and deliver a wider set of environmental and societal objectives related to nature conservation, health and food security"

levy on electricity or transport fuels, which are subject to their own carbon price.

In energy-intensive sectors, such as steel and cement, zero emissions will often be very costly and the technological solutions are not available yet. Regulatory measures and technology support may be more effective to complete their decarbonisation than the very high carbon price that would be required.

A carbon price is still warranted to secure low-hanging fruits and make the polluter pay. A price starting at £50 per tCO_2 by 2020, rising to £160 per tCO_2 by 2050 would ensure equivalence between positive and negative emissions, on which the sector will depend.

For selected trade-exposed sectors support measures may have to be strengthened to protect their international competitiveness, including perhaps border carbon adjustment. However, competitiveness concerns will abate as more and more countries move to a net-zero trajectory.

Agriculture and land use

The reform of the agricultural support system that must happen after Brexit will provide an opportunity to create a more environmentally sustainable and zero-carbon sector. Land use measures can also deliver some of the domestically-sourced negative emissions that a net-zero target will require.

Greenhouse gas emissions in agriculture and land use are currently under-regulated. However, policy interventions need to be holistic and deliver a wider set of environmental and societal objectives (e.g. related to nature conservation, health and food security). A carbon price could be administered on selected emissions sources (such as red meat), complemented by a new payment-for-ecosystem-services approach in a reformed domestic agricultural policy.

A rising carbon price starting at £40 per tCO_2 by 2020 would incentivise many of the key mitigation actions. More expensive measures, such as grain legume rotations, may need complementary regulation or financial support.

Waste

Carbon pricing in the waste sector needs to be embedded into a wider strategy to discourage waste and promote a circular economy. There needs to be awareness of potential environmental trade-offs, for example in waste-to-energy solutions.

The existing landfill tax has been successful in discouraging landfilling and associated greenhouse gas emissions. However, the waste sector now needs a broader-based carbon price, starting at around £40 per tCO_2 by 2020, reaching £100 per tCO_2 by 2050, to discourage greenhouse gas emissions in other aspects of waste management (e.g. related to recycling and waste incineration).

The price signal must be structured to specifically disincentivise greenhouse gas emissions, rather than to reduce the weight or volume of waste.

The strategic move towards carbon-based recycling targets may offer an effective framework with which to measure and reduce greenhouse gas emissions. Assuming this accounting framework provides a robust measure of embedded carbon within products, this may provide the basis to apply a carbon price to those products.

An additional price incentive to encourage negative emissions

A price on (positive) emissions discourages the release of greenhouse gases but on its own it does not encourage negative emissions. Therefore, a complementary price mechanism must be set up to encourage the development and use of negative emissions technology.

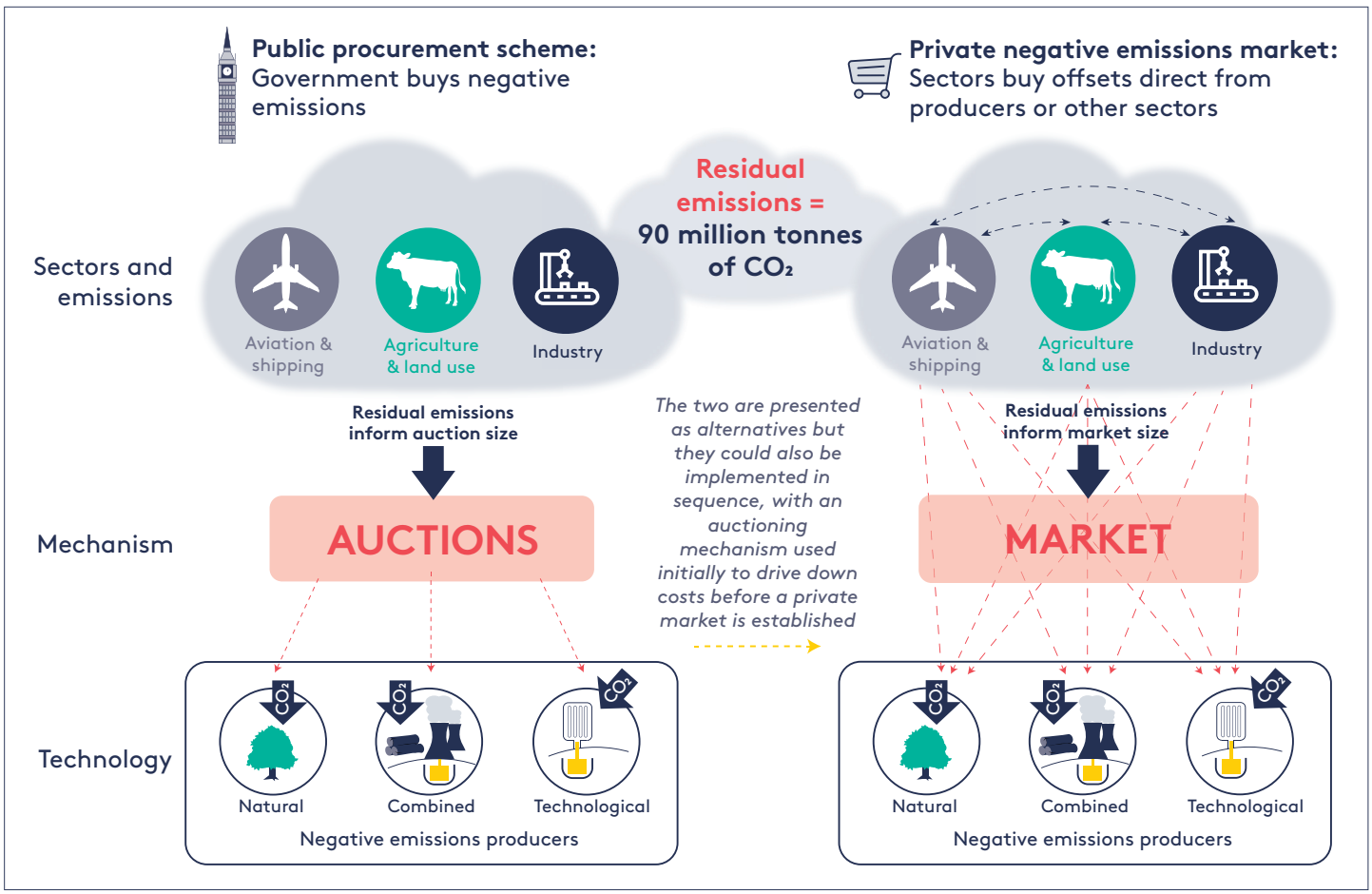
We identify two generic ways in which negative emissions may be rewarded (Figure 3):

- **The first possible mechanism is a public procurement scheme**, through which the Government would purchase negative emissions in proportion to the residual carbon output that its policies have not succeeded in avoiding. The Government could, in the first instance, use revenues raised from a carbon price to pay for negative emissions.
- **The second possible mechanism is a private but regulated offset market**, in which market participants would buy negative emissions in place of paying the carbon price. The cost of negative emissions is likely to be quite high in a free market, so the Government may have to subsidise negative emissions (using carbon tax revenues) to bring the cost of offsets in line with the politically acceptable carbon price.

> "A complementary price mechanism must be set up to encourage the development and use of negative emissions technology"

Figure 3. Pricing schemes for negative emissions

Note: 90 million tonnes of residual emissions calculated by the CCC in its 'Further Ambition' scenario (CCC, 2019). Source: Authors



Conclusions

The Committee on Climate Change has outlined one of the most ambitious emissions reduction targets in the world to date. It should be legislated as soon as possible. To be credible the new target must be accompanied by an equally rigorous and stringent policy framework.

This brief argues that a strong carbon price should be at the core of this framework. Imposing a carbon price at the proposed levels will generate revenues of approximately £20 billion per year for at least the next decade. This creates enough fiscal headroom to enhance the public acceptability of carbon pricing through appropriate redistribution of the revenues, and will help fund research into and the development of negative emissions technologies or other low-carbon projects.

Although the core technologies are known, much about the UK's pathway to net-zero remains uncertain. The numbers presented in this brief present a static representation of cost and must be revised over time, allowing for behaviour change and technological and process innovation.

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