Grantham Research Institute on Climate Change and the Environment

Centre for Climate Change Economics and Policy

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Policy brief
Distributional impacts of a carbon tax in the UK

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Headline issues

- The new net-zero target and Brexit present the UK with an opportunity to review its carbon pricing policy, to ensure distributional fairness.
- Judicious use of carbon tax revenues can help ensure distributional fairness and protection for low-income and fuel-poor households while driving the transition to net-zero emissions in the UK by 2050.
- Revenue recycling schemes that each use a similar amount of revenue can have vastly different impacts depending on their design.

Summary

When assessing the impact of carbon taxation on households with different characteristics, government must assess both 'vertical' and 'horizontal' effects, i.e. the differing effect of the tax on high- and low-income households, and the differing effects on households with similar incomes but different consumption patterns. Assessing these effects will ensure that carbon pricing can be designed to prevent regressive outcomes and a rise in fuel poverty where there is within-income group variation in expenditure on energy.

Without mitigation measures, a carbon tax on energy fuels is regressive, hitting low-income households disproportionately. But in the transport sector a carbon tax is largely progressive as the share of income spent on transport increases with income.

Carbon tax revenues should be explicitly used to correct undesirable distributional outcomes. Conventional fiscal thinking that sees all revenue treated as general tax must change to ensure that the impacts of carbon pricing are distributed fairly and that the policy becomes more politically and socially acceptable. For example, we show that using 33 per cent of revenues for energy efficiency can ensure fuel-poor households are not adversely affected by carbon taxation; and, depending on the design of the revenue recycling, distributing between 19 and 70 per cent of revenues to households via a uniform or targeted cash transfer can ensure that carbon tax policy is progressive.

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 **Josh Burke, Sam Fankhauser, Alex Kazaglis, Louise Kessler, Naina Khandelwal, Peter O'Boyle** and **Anne Owen.**

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Carbon pricing: the UK context

The UK Government has committed to reducing greenhouse gas emissions to net-zero by 2050 and is also facing the implications of leaving the European Union. This confluence presents an opportunity to reconsider options for pricing carbon, a policy that is shown to reduce emissions.

However, carbon pricing is often hard to implement, as it is more transparent than other policies about its economic winners and losers. Consumers are extremely sensitive to changes in the prices of vital provisions such as energy, transport and food. Recent protests in Chile, France and Ecuador, as well as unrest in North Africa in 2011, demonstrate this to be true (Hallegatte, 2019). As a result, carbon prices are often too low to be truly effective, many sectors are not covered, and in those that are, significant exemptions dilute policy efficacy.

In its design of a carbon tax, the UK must carefully consider how costs and benefits are distributed across society, to achieve both immediate political feasibility and the durability of carbon policy over time. With the Government's new net-zero target there is an important opportunity to scrutinise conventional fiscal thinking – especially that all revenue is treated as general tax – to ensure distributional fairness.

This study explores the distributional impacts of a net-zero-consistent carbon price across different household types and income deciles in the UK (see Box 1), and examines which combination of interventions may reduce carbon consumption and still be progressive.

Addressing the regressivity of carbon taxes through revenue recycling

Revenue recycling can help to reduce the potentially regressive effects of carbon pricing by redistributing carbon revenues back to targeted low-income and/or fuel-poor households. Around the world there are several revenue recycling options in operation within the 28 jurisdictions that currently have a carbon tax, each with its own advantages and disadvantages.

The two most common options are direct financial compensation (either targeted or uniform) for households and providing a stimulus for energy efficiency improvements in households. Energy efficiency may reduce regressivity by increasing total energy savings and thereby lowering bills. These options form the basis of our designed compensation scheme.

Box 1. Overview of modelling

We modelled the impacts of a carbon tax of £50 per tonne of carbon dioxide in 2020, rising to £75 in 2030, on:

- **Five types of household** that differ in terms of income, occupancy, fuel type, fuel poverty status, tenure and construction features
- **The different income deciles**, based on dividing the 27 million households that were in the UK in 2016 into 10 equal sized groups by income, so each decile represents 2.7 million households
- **Different regions of the UK**.

For the income decile part of the study we modelled eight scenarios:

- Scenario 1 models the current situation (the baseline scenario).
- Scenario 2 models the impact of a carbon tax of £50/tCO_2 in 2020, rising to £75/tCO_2 in 2030 without any revenue recycling: that is, revenues accrue to the Exchequer as general tax.
- Scenarios 3–6 explore different tax rates.
- Scenarios 7–8 explore different recycling assumptions, using the central tax scenario.

For more details see our full policy reports: Burke et al. (2020 a; b)

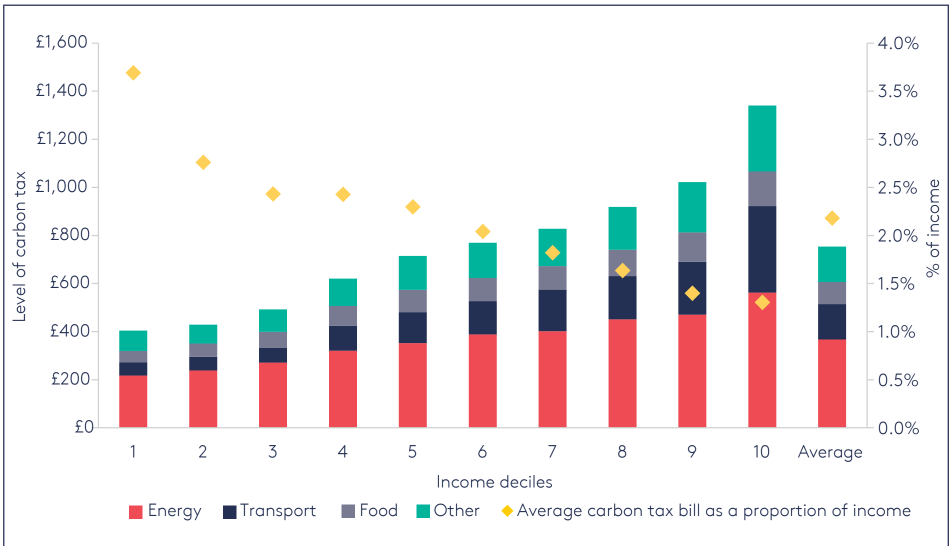
Defining what is 'equitable' is a political judgment. Fuel poverty is one benchmark. Through this lens, an equitable policy would see the UK's fuel-poor households and income deciles 1–3[1] (who accounted for over 90 per cent of fuel poverty cases in 2019, according to the Government) left either better off from a carbon tax or feeling no net impact once compensatory policies are implemented.

Effects along the income dimension

The vertical distributive effect of a carbon tax – the variation in impact along the income dimension – is found to be regressive. In other words, lower income households are hit harder than wealthier households. This is because the carbon tax represents a larger proportion of their income (see Figure 1) and these households may

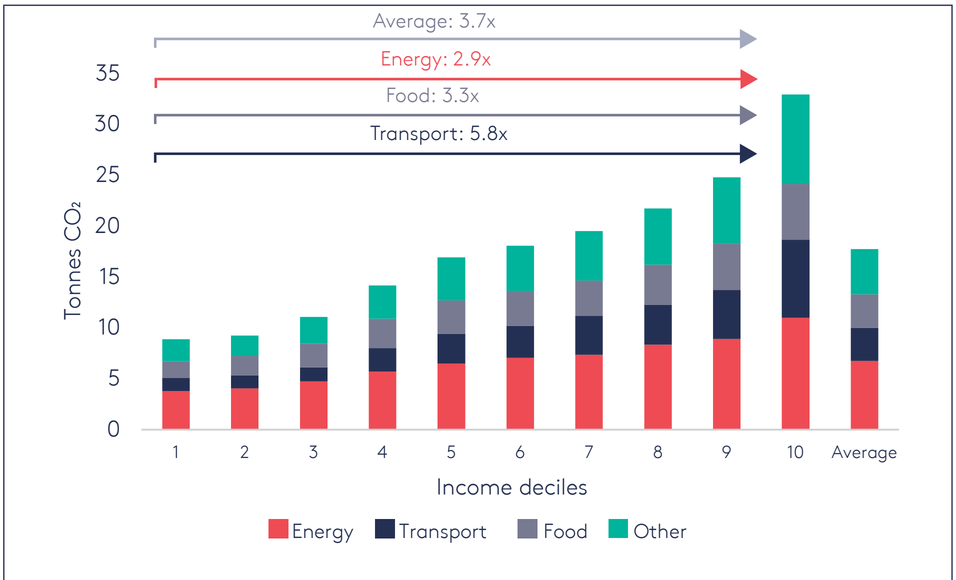
1. Decile 1 is the lowest-income decile and Decile 10 the highest-income decile.

Figure 1: Total carbon tax impact for each decile, split between food, transport, energy and other, for scenario 2* in 2030



*Scenario 2 models the impact of a carbon tax of £50/tCO_2 in 2020, rising to £75/tCO_2 in 2030 without any revenue recycling: that is, revenues accrue to the Exchequer as general tax. 'Other' includes consumables such as furniture, glassware and education. Source: Authors

Figure 2. Household emissions by income deciles in 2030 (tonnes CO_2e)



Note: Arrows indicate the greater magnitude of decile 10's emissions compared with decile 1's. 'Other' includes consumables such as furniture, glassware and education. Source: Authors

"With a similar amount of revenue for both recycling options – roughly 70 per cent – the redistribution policy can be either somewhat or extremely progressive"

Box 2. Transport taxes tend not to be regressive

Across the sectors of transport, food, energy and 'other', we calculate that in 2030 UK households in the highest income decile will emit 3.7 times more carbon dioxide-equivalent (CO_2e) than decile 1 and earn 9.4 times as much money. The main difference in emissions by decile is in the transport sector: high-income households tend to use more emissions-intensive transport – such as aviation – more frequently than lower income households. This is evidenced by the highest income households emitting 5.8 times as much CO_2e from transport use as the lowest income households (Figure 2 above).

have limited ability to offset higher energy costs through improving the insulation of their homes or by replacing low energy-efficient products with more efficient alternatives.

Before compensation, the introduction of a carbon tax has regressive impacts on household bills: poorer households, specifically deciles 1 and 2, spend a much higher proportion of their income on the tax than better-off households, at 3.7 per cent for decile 1 in 2030 compared with 1.3 per cent for income decile 10. Most carbon tax is paid on energy (heating and electricity), with relatively small differences across deciles. While the household income in decile 10 is 9.4 times larger than in decile 1, decile 10 households spend 2.6 times more on carbon tax on energy than decile 1. A tax on energy (heat and electricity) is the most regressive, as decile 10's greenhouse gas emissions from energy are 2.9 times the amount of decile 1's.

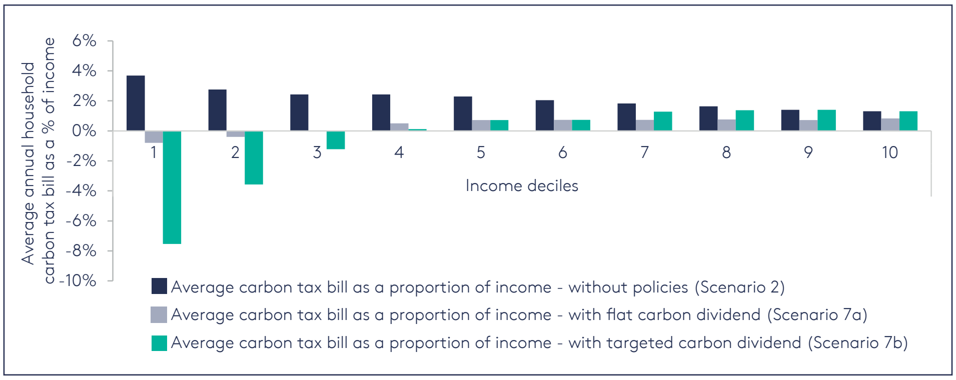
Decile 10's spending on a carbon tax increases to 3.1 times more than decile 1 for food and 6.5 times more for transport (as shown in Figure 1). Higher income deciles have a higher tax spend on transport, which is consistent with the findings from the literature review. A carbon tax on transport is therefore not necessarily regressive (see Box 2).

Revenue recycling options

To prevent regressive outcomes, the policy design takes into account the effectiveness of two types of dividend revenue recycling schemes. With a similar amount of revenue for both options – roughly 70 per cent of total revenues – the redistribution policy can be either somewhat or extremely progressive: after a flat transfer the tax bill

Source: Authors

Figure 3. Average annual household carbon tax bills in 2030 as percentage of income under different revenue recycling policies



becomes -1 per cent of the income of a household for decile 1, and with a targeted transfer this rises to -8 per cent (Figure 3). Negative percentages mean that these income deciles are left with a net increase in wealth from the carbon tax.

Transfers reduce the carbon tax paid by the different deciles. For deciles 1, 2 and 3 it even results in negative net carbon tax payments – the redistributed amount received is higher than the tax. The average household tax bill as a proportion of income for the lower income deciles differs widely across the three scenarios. For higher income households the tax bill as a proportion of income remains fairly stable across different scenarios. Scenario 7a, with a flat carbon dividend of £492 per household, results in a fairly neutral effect on the distribution of cost across the deciles, whereby the proportion of income spent on energy bills is largely equal across all deciles. A number of studies have found that a neutral cost distribution – all citizens paying the same share of income – increases policy acceptability.

Effects according to household differences

It is also important to consider the ways in which households with similar incomes otherwise differ. These can be described as 'horizontal effects'. These differences include household composition, tenure and location, and they can determine the extent to which households are affected by carbon taxes and if they are classified as fuel-poor (Figure 4).

Income is not always a good predictor of fuel poverty. We selected household 'archetypes' for this study to represent a variety along two dimensions that are particularly important for carbon tax impacts: heating fuel and income level. For example, in Figure 4 below, household types 2 and 5 are both in income decile 4, but only one (household 5) is in fuel poverty. Household 4 fits into income decile 1 but is not fuel-poor, whereas household 3 fits into income decile 2 but is considered fuel-poor.

Key findings on the policy design

The net impact of the carbon tax policy is minimal for most households after they receive financial energy efficiency support, net of insulation costs. For most household archetypes, energy savings from energy efficiency (and low-carbon heating where applicable) are greater than the carbon tax imposed in 2030. This implies, in general, that even under a higher carbon tax on energy, households do not require compensation in excess of the support for solid wall insulation costs once energy savings start to have an effect. However, compensatory measures, especially for fuel-poor households, need to be considered in the years before energy efficiency installation measures are adopted.

Fuel-poor households experience a minimal increase in their energy bills, as targeted by the policy – in our study these are off-gas-grid households and low-income, high energy expenditure households. Off-gas-grid households switch from carbon-intensive oil heating to electric heat pumps, and therefore pay a significantly lower amount of carbon tax after switching, compensating for the net costs of energy efficiency and low-carbon heating measures. Similarly, low-income, large energy consuming households receive energy efficiency support for the net costs of energy efficiency insulation measures.

> "For most household archetypes, energy savings from energy efficiency – and low-carbon heating where applicable – are greater than the carbon tax imposed in 2030"

Figure 4. Impacts of a carbon tax on different household types in the UK in 2030

1. London

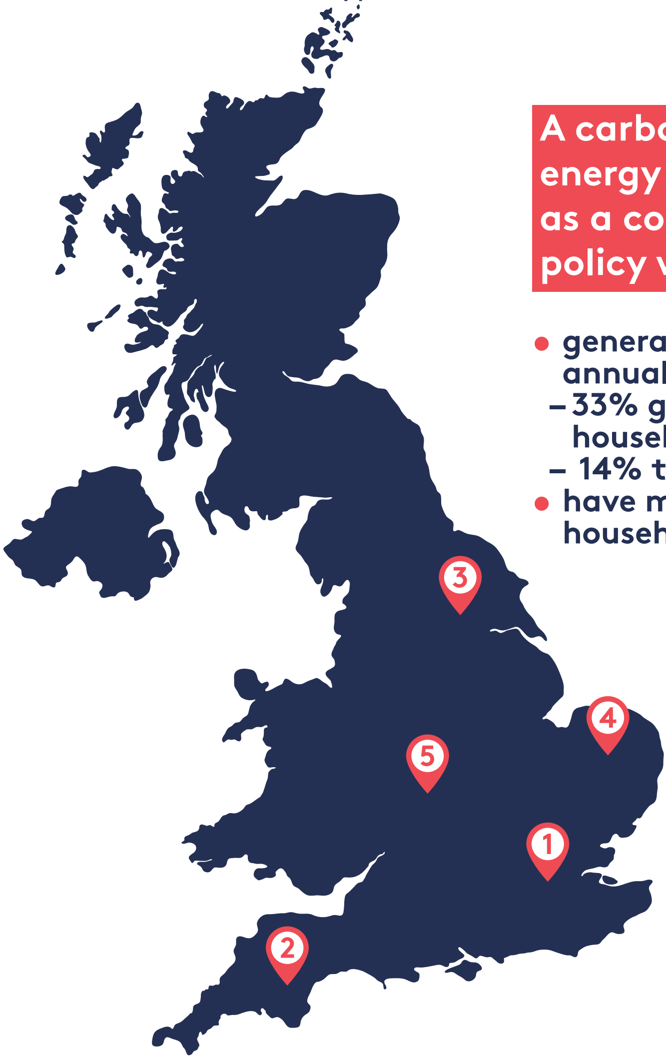
+10%

ENERGY BILLS: Increase by 10% mainly due to energy price rises
COMPENSATION:
CARBON TAX IMPACT: 2 percentage points

2. South West England

+12%

ENERGY BILLS: Increase by 12% solely due to energy price rises
COMPENSATION: None
CARBON TAX IMPACT: None



A carbon tax with energy efficiency as a compensatory policy will:

- generate approx. £5bn annually from 2021–30:
  - 33% goes to fuel-poor households
  - 14% to non-fuel-poor
- have minimal impact on household bills

3. Yorkshire and the Humber

FP +2%

Powered by oil and electricity but switches to electric heat pump
ENERGY BILLS: Increase by 2% solely due to oil price rises
COMPENSATION: £+
CARBON TAX IMPACT: None

4. East of England

+10%

ENERGY BILLS: Increase by 10% mainly due to energy price rises
COMPENSATION:
CARBON TAX IMPACT: 7 percentage points

5. West Midlands

FP +7%

ENERGY BILLS: Increase by 7% solely due to energy price rises
COMPENSATION:
CARBON TAX IMPACT: None

KEY

INCOME	OCCUPANCY	FUEL TYPE	FP	+%	£+
INCOME	OCCUPANCY	FUEL TYPE	Household in	ENERGY BILL	COMPENSATION
Low/Middle/High	No. of people	Electricity/Gas/Oil	FUEL POVERTY	Percentage increase	Energy efficiency/Financial support

We modelled the effect of a carbon tax of £50 per tonne of CO_2 in 2020, rising to £75 in 2030 as recommended in Burke et al. (2019) *How to price carbon to reach net-zero emissions in the UK* (www.lse.ac.uk/GranthamInstitute/publications/)

The five household types are representative of the entire UK and were selected to show variety in terms of income and fuel.

Households with solid wall insulation require greater compensation due to the high upfront costs of installation. Costs of cavity wall and loft insulation are more than offset by the incurred energy savings. The average savings on bills from energy efficiency are about £200, which are in line with the Committee on Climate Change's average saving estimate of £150 (Committee on Climate Change, 2019).

The differences in the average energy bill increase among the case-study households arise from differences in fuel used for space and water heating under the proposed carbon tax scenario. Dual-fuel households pay a much higher carbon tax in 2030 than electrically-heated households as the electricity sector strives towards decarbonisation between 2020 and 2030, lowering the carbon content of electricity consumed and thus carbon tax payments.

The adoption of energy efficiency improvements and low-carbon heating reduces emissions. Along with electricity sector decarbonisation, these improvements decrease residential gas emissions by 9 per cent and residential electricity emissions by 43 per cent between 2020 and 2030.

Conclusions

This study projects a range of revenues from the proposed carbon tax, depending on its design and associated compensatory policies:

- Before compensation, revenues range from £5–36 billion annually.
- After compensation (where revenues are used for energy efficiency policies and household dividends), between 30 and 81 per cent of total revenues remain.

This leaves significant fiscal headroom to increase public acceptability of carbon pricing through appropriate redistribution of the revenues.

We have demonstrated that using the revenues for energy efficiency support can be a powerful means to offset some of the regressive social impacts of carbon taxes in the UK, particular for fuel-poor homes.

It is important to recognise limitations to our approach: we do not have data on price elasticities of energy across the distribution of expenditure, which are important when trying to understand the distributional effect of the carbon price policy we outline.

Recycling revenue as a compensatory policy does not, alone, provide a sufficient means to increase the acceptability of carbon taxes. Understanding voter aversion is critical for navigating the political economy of carbon tax policy. Carratini et al. (2019) offer additional, pragmatic ways in which this can be done. This includes phasing in carbon taxes over time and clearly communicating how the revenue will be used.

Our study also recognises that the salience of carbon pricing varies from sector to sector and therefore must be supported by complementary policies.

But carbon pricing will be central to achieving net-zero emissions and not only provides an efficient mechanism by which to do this, but also the financial means to fund the transition and ensure it is equitable. Our study presents insights into how governments may wish to do this.

"Using the revenues for energy efficiency support can be a powerful means to offset some of the regressive social impacts of carbon taxes in the UK"

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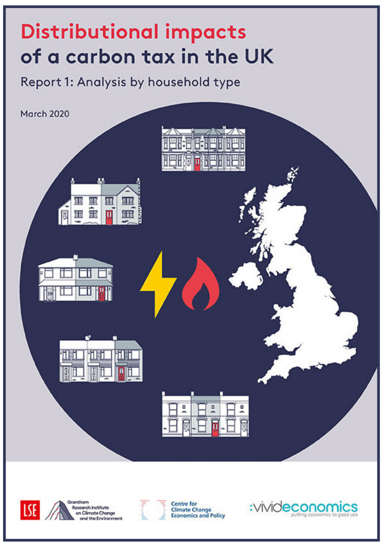
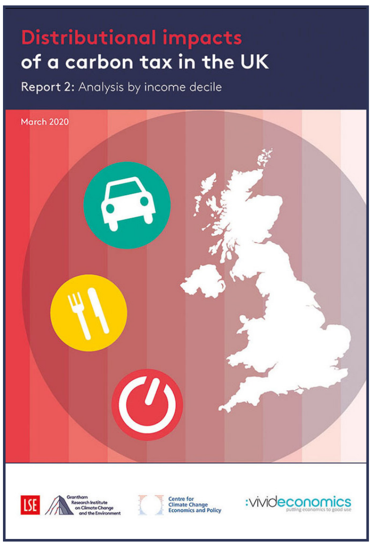
Download the full reports at www.lse.ac.uk/GranthamInstitute/publication/distributional-impacts-of-a-carbon-tax-in-the-uk





Grantham Research Institute on Climate Change and the Environment

London School of Economics and Political Science

Houghton Street, London, WC2A 2AE

e gri.policy@lse.ac.uk
w www.lse.ac.uk/granthamInstitute
www.climate-laws.org

About the authors
Josh Burke is a Policy Fellow at the Grantham Research Institute on Climate Change and the Environment. Sam Fankhauser is Director of the Grantham Research Institute on Climate Change and the Environment and Co-Director of CCCEP. Alex Kazaglis is a Principal at Vivid Economics. Louise Kessler is an Engagement Manager at Vivid Economics. Naina Khandelwal is an Economist at Vivid Economics. Julia Bolk and Peter O'Boyle are Analysts at Vivid Economics. Anne Owen is an Academic Fellow at the Sustainability Research Institute, University of Leeds.

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