

Measuring Carbon Inequality in Scotland

INTRODUCTION

In recent years a number of studies have sought to highlight the role of ‘carbon inequality’ in fuelling the global climate crisis.¹ The concept aims to highlight the fact that climate change and inequality are inherently linked, and that those on higher incomes contribute disproportionately to climate breakdown, while those on lower incomes are disproportionately impacted by it. Studies have sought to examine the extent of carbon inequality both within individual countries and globally.^{2,3}

To date however, no robust estimates of the scale of carbon inequality have been produced for Scotland. This paper aims to address this by presenting new data on the carbon footprint of households in Scotland across the income distribution, using a dataset produced by the University of Leeds.ⁱ The data presented in this paper is an average of the three-year period from 2017-2019. Although more recent data for 2020 is available, this data is unreliable due to the impact of the Covid-19 pandemic on emissions and consumption patterns. The full methodology for producing the data has been provided in the methodology section.

KEY FINDINGS

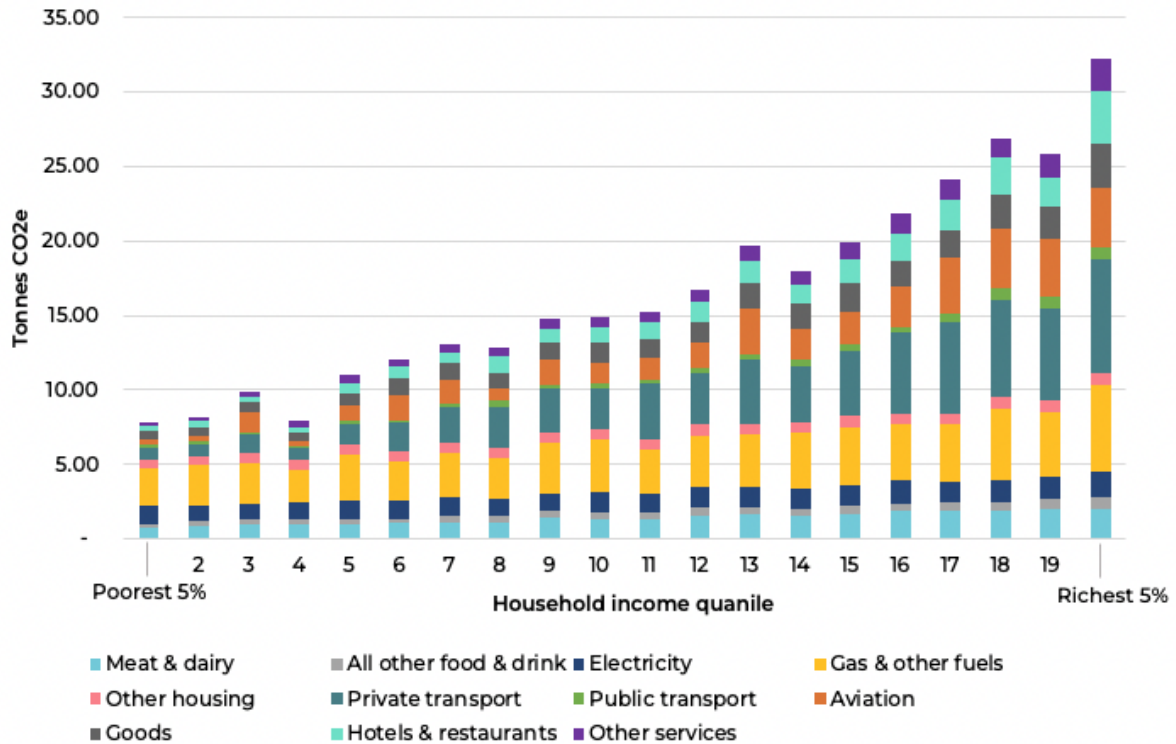
Our analysis estimates the carbon footprint of households in Scotland split across 20 income quantiles (each group representing 5% of Scottish households). Figure 1 shows the main results of the analysis.

Across 2017-2019, the average carbon footprint of a household in the lowest income group was 8 tonnes CO₂e. In contrast, the average carbon footprint of a household in the highest income group was 32 tonnes CO₂. As such the carbon footprint of the richest 5% of households in Scotland was 4.1 times greater than the poorest 5% of households. The chart also disaggregates the carbon footprint of households in each income group across 11 different consumption categories. A breakdown of the goods and services contained in each consumption category is provided in the methodology section below.

ⁱ Future Economy Scotland would like to thank Dr Anne Owen from the University of Leeds for undertaking the data analysis in this report.

Figure 1: The carbon footprint of Scotland's richest 5% of households is four times greater than the poorest 5% households

Scottish carbon footprint split by household income across 20 quantiles and by consumption category, tonnes CO₂e (average of 2017-2019)



Source: University of Leeds, Living Costs and Food Survey

Note: Household income data is unequivalised.

In order to further illustrate the differences within different consumption categories, Table 1 below shows the ratio between the carbon footprint of the richest and poorest 5% of households in each category.

While some categories such as electricity show little difference between the lowest and highest income groups, other categories exhibit very large differences.

Table 1: Carbon inequality is highest in the transport and hospitality sectors

Carbon footprint of households in the top and bottom household income groups, tonnes CO₂e (average of 2017-2019)

Category	Carbon footprint (tonnes CO ₂ e)		
	Poorest 5% of households	Richest 5% of households	Ratio
Meat & Dairy	0.7	2.0	2.8
All other food & drink	0.3	0.8	2.8
Electricity	1.2	1.7	1.4
Gas & other fuels	2.5	5.8	2.3
Other housing	0.6	0.9	1.4
Private transport	0.8	7.6	9.9
Public transport	0.2	0.9	5.1
Aviation & other transport	0.4	4.0	10.8
Goods	0.6	3.0	5.2
Hotels & restaurants	0.3	3.5	10.9
Other services	0.3	2.2	7.3
TOTAL	7.9	32.3	4.1

Note: 'Poorest 5% of households' refers to the consumption emissions of households in the bottom 5% income quantile. 'Richest 5% of households' refers to the consumption emissions of households in the top 5% income quantile. Household income data is unequivalised.

Transport remains the highest-emitting sector in Scotland. However, with regards to private transport (which includes private cars and motorcycles), the carbon footprint of the richest 5% of households was 10 times higher than the poorest 5% of households in the period 2017–2019. With regards to aviation, the carbon footprint of the richest 5% of households was 11 times higher than the poorest 5% of households. For public transport (which includes rail and buses), it was 5 times higher.

Other categories where carbon footprints vary widely across the income distribution are hotels and restaurants, goods, and other services. With regards to hotels and restaurants, the carbon footprint of the poorest 5% of households was only 0.32 CO₂e across 2017-2019. However, for the richest 5% of households it was ten times higher, at 3.48 CO₂e. For goods (which includes clothing, furniture and consumer goods), the carbon footprint of the richest 5% of households was 5 times higher than the poorest 5% of households. For other services (which includes health, education and financial services), the carbon footprint of the richest 5% of households was 7 times higher than the poorest 5% of households. These results are broadly consistent with similar studies examining carbon inequality in the UK as a whole.⁴

DISCUSSION

The Scottish Government has committed to delivering a just transition to net zero by 2045. Since 1990 greenhouse gas emissions in Scotland have fallen by 49.9%. To date however, progress in reducing emissions has been driven by the energy sector. Going forward, the Scottish Government will need to take bold steps to accelerate decarbonisation across the economy – particularly in sectors such as transport, housing and industry.

A key question for policy relates to how the cost of reducing emissions in these sectors are shared. Delivering a just transition means ensuring that costs are shared in a way that is fair and just. In designing policy, it is important that costs are shared in a way that is proportionate to households' contribution to Scotland's carbon footprint, as well as households' ability to pay for decarbonisation measures. Future Economy Scotland will be doing more work on this in the months ahead as part of our just transition project.⁵

METHODOLOGY

Data selection

The analysis uses a dataset produced by the University of Leeds that calculates a set of Carbon Multipliers by COICOP category, which is used in the production of the Official UK Consumption based account.⁶ These are calculated by taking the total CO₂e consumption emissions associated with household consumption of different products and dividing by the total spend on that product as reported by the Living Costs and Food survey (LCFS). This means that an individual household survey can be extracted from the LCFS and the weekly spends multiplied by the carbon multipliers, then multiplied by 52 weeks to give that households annual carbon footprint.

The LCFS reports the Government Office Region that the household resides in. Households in Scotland are coded as '12', and this data is used in our analysis.

Time period

The UK Carbon footprint for 1990-2020 was released in Spring 2023.⁷ However, 2020 covers the start of the COVID-19 pandemic, which triggered stark differences in the consumption of transportation, holidays and restaurant spend. As a result, it was decided that this project should use years prior to 2020 for analysis. The UK economy and carbon footprint was relatively flat in terms of growth post 2016 so summing together several years' worth of data would not pose problems. As such, the analysis in this paper uses Scottish surveys from the 2017, 2018, 2019 Living Cost and Food Survey, giving a sample size of 2,327 surveys.

Sample size

The LCFS achieves a sample size of between 5,000 and 7,000 households annually. Each survey is weighted by how much of the total UK each particular household type is estimated to represent, and the sum of the weights is equal to the total number of households in the UK. For this project we want to look at different income groups in Scotland, meaning that we do not have the full sample set to use.

Table 2: Number of Scottish surveys in the LCFS in 2019, 2018 and 2017

Year	Number of Scottish surveys
2019	788
2018	816
2017	723

Table 1 shows that in 2019, there were 788 surveys. If we were to group the data into 20 income quantiles (each group representing 5% of Scottish households), there would be just 39 surveys for each group. This number was felt to be too low for a representative sample. Including all the surveys from 2017-2019 gives a sample size of 2,327 surveys, allowing for over 150 surveys in each income 5% income quantile. As such, we can be more confident that the average footprint calculated for each group is representative of the entire population.

Consumption categories

Many footprint projects divide household footprint categories into five categories: food, housing, transport, goods and services. However, we felt that these groupings were a little too broad. For example, it is not possible to understand whether the group with the highest footprint spends on private transport or aviation. For the results to be useful from a policy perspective, more detail is required. However, too much detail can be confusing and may distract from the overall picture. A set of categories is required that shows both the most important categories in terms of size of impact and also reveals differentiation in impact from the richest to the poorest. After some experimentation the following list was decided on:

- Meat and dairy
- All other food & drink
- Electricity
- Gas and other fuels
- Other housing
- Private transport
- Public transport
- Aviation & other transport
- Goods
- Hotels & restaurants
- Other services

A full list of the goods and services contained in each of these consumption categories is provided in Annex 1.

Households, per capita or equivalised income groups?

In order to make meaningful comparisons, footprints are often reported at a per capita level. However, per capita reporting of consumption measures can be misleading given that the total population includes children and infants who have no spending power of their own, and that most decisions on purchasing are made at the household level. In addition, LCFS's reporting level is at the household level, therefore for this study our findings are reported at the household unit.

However, an important consideration when using household level data is that households vary in composition. A single elderly pensioner household may require much less food than a family of four but the pensioner may use the same amount of energy to heat the home. Household income groupings are also an issue when you take composition into account. Homes in the lowest decile are much more likely to be single person households, and the richest group often contains households with more adult earners.

Some studies aim to address this by applying an equivalisation weighting that adjusts household income to take account of the differences in a household's size and composition.⁸ However, after careful consideration, we decided to use unequivalised data for this study. This is because our aim is to present an accurate picture of household carbon footprints in Scotland, given existing patterns of household size and composition.

In addition, many low-carbon policies in the UK are funded through taxing the household's energy bill and so operate at the household unit. Converting to equivalent sized per capita households would mean that we would lose sight of real-life costs to households for certain policy options, because these costs would be reported on an equivalised per capita basis. This approach is consistent with that used in other studies examining carbon footprints in the UK context.⁹

However, care should be taken to acknowledge the impact of differences in household size and composition when interpreting this data, and examining potential policy implications.

ANNEX 1: CONSUMPTION CATEGORIES USED

The analysis in this paper uses a dataset produced by the University of Leeds that calculates a set of Carbon Multipliers by COICOP category, which is used in the production of the Official UK Consumption based account. The Classification of Individual Consumption According to Purpose (COICOP) is the international reference classification of household expenditure. The full list of COICOP codes included in each consumption category is shown in Table 3 below.

Table 3: Consumption categories used

Consumption category	COICOP codes
Meat & dairy	1.1.2 Meat 1.1.4 Milk, cheese and eggs
All other food & drink	1.1.1 Bread and cereals 1.1.3 Fish and seafood 1.1.5 Oils and fats 1.1.6 Fruit 1.1.7 Vegetables 1.1.8 Sugar, jam, honey, chocolate and confectionery 1.1.9 Food products not elsewhere classified 1.2.1 Coffee, tea and cocoa 1.2.2 Mineral waters, soft drinks, fruit and vegetable juices 2.1.1 Spirits 2.1.2 Wine 2.1.3 Beer
Electricity	4.5.1 Electricity
Gas & other fuels	4.5.2 Gas 4.5.3 Liquid fuels 4.5.4 Solid fuels 4.5.5 Heat energy
Other housing	4.1.1 Actual rentals paid by tenants 4.1.2 Other actual rentals 4.3.1 Materials for the maintenance and repair of the dwelling 4.3.2 Other services for the maintenance and repair of the dwelling 4.4.1 Water supply 4.4.2 Refuse collection 4.4.3 Sewage collection
Private transport	7.1.1 Motor cars 7.1.2 Motorcycles 7.1.3 Bicycles 7.1.4 Animal drawn vehicles 7.2.1 Spare parts and accessories for personal transport equipment 7.2.2 Fuels and lubricants for personal transport equipment 7.2.3 Maintenance and repair of personal transport equipment 7.2.4 Other services in respect of personal transport equipment
Public transport	7.3.1 Passenger transport by railway 7.3.2 Passenger transport by road 7.3.5 Combined passenger transport

Aviation & other transport	<ul style="list-style-type: none"> 7.3.3 Passenger transport by air 7.3.4 Passenger transport by sea and inland waterway 7.3.6 Other purchased transport services
Goods	<ul style="list-style-type: none"> 2.2.1 Tobacco 3.1.1 Clothing materials 3.1.2 Garments 3.1.3 Other articles of clothing and clothing accessories 3.1.4 Cleaning, repair and hire of clothing 3.2.1 Shoes and other footwear 3.2.2 Repair and hire of footwear 5.1.1 Furniture and furnishings 5.1.2 Carpets and other floor coverings 5.1.3 Repair of furniture, furnishings and floor coverings 5.2.1 Household textiles 5.3.1 Major household appliances whether electric or not 5.3.2 Small electric household appliances 5.3.3 Repair of household appliances 5.4.1 Glassware, tableware and household utensils 5.5.1 Major tools and equipment 5.5.2 Small tools and miscellaneous accessories 5.6.1 Non-durable household goods 5.6.2 Domestic services and household services 6.1.1 Pharmaceutical products 6.1.2 Other medical products 6.1.3 Therapeutic appliances and equipment 9.1.1 Equipment for the reception, recording and reproduction of sound and pictures 9.1.2 Photographic and cinematographic equipment 9.1.3 Information processing equipment 9.1.4 Recording media 9.1.5 Repair of audio-visual, photographic and information processing equipment 9.2.1 Major durables for outdoor recreation 9.2.2 Musical instruments and major durables for indoor recreation 9.2.3 Maintenance and repair of other durables for recreation and culture 9.3.1 Games, toys and hobbies 9.3.2 Equipment for sport, camping and open-air recreation 9.3.3 Gardens, plants and flowers 9.3.4 Pets and related products 9.5.1 Books 9.5.2 Newspapers and periodicals 9.5.3 Miscellaneous printed matter 9.5.4 Stationery and drawing materials 12.1.2 Electrical appliances for personal care 12.1.3 Other appliances, articles and products for personal care 12.3.1 Jewellery, clocks and watches 12.3.2 Other personal effects
Hotels & restaurants	<ul style="list-style-type: none"> 11.1.1 Restaurants, cafes and the like 11.1.2 Canteens 11.2.1 Accommodation services

Other services

- 6.2.1 Medical services
- 6.2.2 Dental services
- 6.2.3 Paramedical services
- 6.3.1 Hospital services
- 8.1.1 Postal services
- 8.2.1 Telephone and telefax equipment
- 8.3.1 Telephone and telefax services
- 9.3.5 Veterinary and other services for pets
- 9.4.1 Recreational and sporting services
- 9.4.2 Cultural services
- 9.4.3 Games of chance
- 10.1.1 Pre-primary and primary education
- 10.2.1 Secondary education
- 10.3.1 Post-secondary non-tertiary education
- 10.4.1 Tertiary education
- 10.5.1 Education not definable by level
- 12.1.1 Hairdressing salons and personal grooming establishments
- 12.4.1 Social protection
- 12.5. Insurance
- 12.6. Other financial services not elsewhere classified
- 12.7. Other services not elsewhere classified

ENDNOTES

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- ⁵ Future Economy Scotland (2023). *Transforming the Economy to Deliver a Just Transition*. Retrieved from: <https://www.futureeconomy.scot/publications/58-transforming-scotland-s-economy-to-deliver-a-just-transition-framing-paper>
- ⁶ The Classification of Individual Consumption According to Purpose (COICOP) is the international reference classification of household expenditure. See here for more information: https://unstats.un.org/unsd/classifications/unsdclassifications/COICOP_2018_-_pre-edited_white_cover_version_-_2018-12-26.pdf
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- ⁸ Gough I, Abdallah S, Johnson V, Ryan-Collins J, Smith C (2011) *The distribution of total greenhouse gas emissions by households in the UK, and some implications for social policy* (Vol. 152). Retrieved from: <http://ideas.repec.org/p/cep/sticas/case152.html>
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