pact production and consumption transformations centre

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Why Do Consumption-Based Emissions Matter?

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About the centre

The Production and Consumption Transformations Centre (PACT) brings together researchers, policymakers, businesses and civil society to understand the wider economic, social and political systems that drive emissions.

By developing practical, evidence-based solutions, the centre supports a transition that not only cuts emissions, but also protects jobs, shares costs and benefits fairly, and builds a more resilient, sustainable economy.

About the report

This publication serves as an evidence briefing alongside the release of the 2026 update to *Carbon Footprint for the UK and England to 2023* which was published by the Department for Environment, Food and Rural Affairs (DEFRA) on the 30th June, and updated on the 7th July.

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Summary

The UK's consumption-based emissions provide a comprehensive measurement of the greenhouse gas emissions (GHGs) that are generated by UK consumption. The latest figures released on 30th June 2026, show a continued reduction in the UK's carbon footprint, with consumption-based emissions reducing by 4% between 2022 and 2023 and by 24% since 1990.

This briefing explains what these figures mean within the broader context of the UK's progress towards its net zero targets, as well as some of the potential drivers of changes in the UK's consumption-based emissions.

We discuss how using a range of accounting methods to evaluate emissions can open new opportunities for climate mitigation strategies, and how addressing consumption-based emissions and energy demand can create a higher potential for reducing emissions overall. Furthermore, such strategies can contribute to wider economic and social goals and are becoming increasingly popular with the public.

What are consumption-based emissions?

There are three different ways of measuring the GHG emissions that each country is responsible for: territorial, production or consumption-based emissions accounting.

- **Territorial:** In much of climate policy, such as the UK's Nationally Determined Contributions (NDCs) under the Paris Agreement, the UK's domestic carbon budgets or the 2050 net zero target under the Climate Change Act, the territorial measure is used. Territorial emissions include all those produced within the territorial borders of the UK, estimated to be **389 $MtCO_2e$ in 2023** (DESNZ, 2026).
- **Production:** These are allocated based on the residency of the person or company that emits them. This principle allows for the inclusion of international aviation and shipping emissions of UK registered companies, as well as emissions associated with biomass. It is therefore higher than territorial emissions, estimated to be **479 $MtCO_2e$ in 2023** (ONS, 2026).
- **Consumption**: These are the emissions embodied in the goods and services that are consumed within the UK, regardless of whether they were emitted within the UK's territory or not. This is sometimes referred to as the UK's carbon footprint. Thus, consumption-based accounting measures emissions along the whole supply chain of a given product and allocate them to the country where that product was purchased. Consumption-based emissions include emissions embodied in imports of goods and services (referred to as imported emissions) and excludes those embodied in exported goods and services consumed in other countries (Afionis et al., 2017). On 30th June 2026, a new statistical release estimated the UK's consumption-based emissions to be **699 $MtCO_2e$ in 2023** (DEFRA, 2026; Owen, 2026).

Figure 1, taken from the latest consumption-based emissions release (Owen, 2026), compares the relationship of these three accounting measures, while **Figure 2** compares their totals in $ktCO_2e$ over the past 35 years.

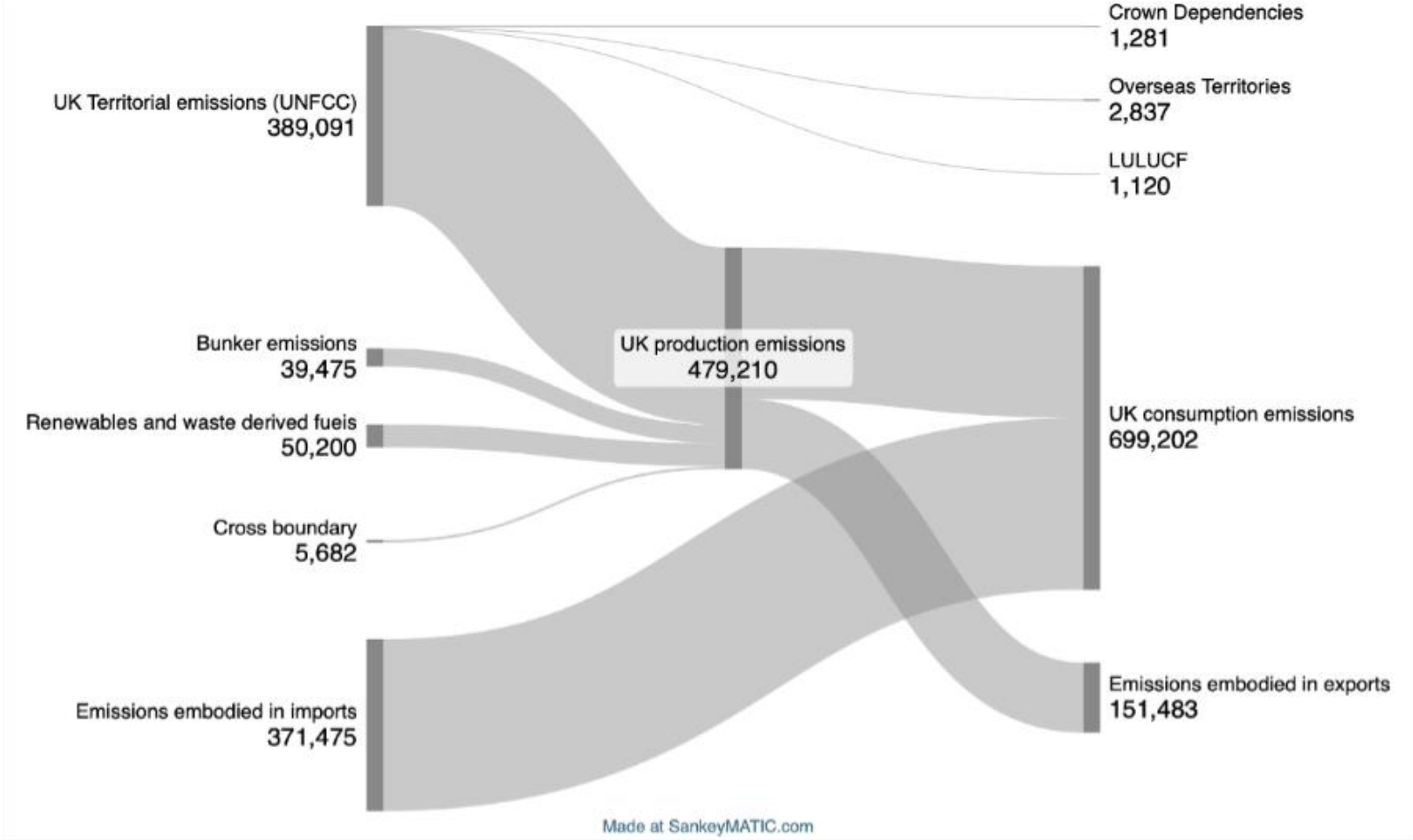

Figure 1: Relationship between the UK's Territorial, Production and Consumption emissions in 2023 (all values in $ktCO_2e$)[1] (Owen, 2026).

[1] Figure 1 uses environmental account data released prior to June 2026. This data was used in the construction of the consumption accounts published in July 2026. Figure 2, below, updates the Production Account with the latest data and the production emission estimate for 2023 is slightly different from the measure shown in Figure 1.

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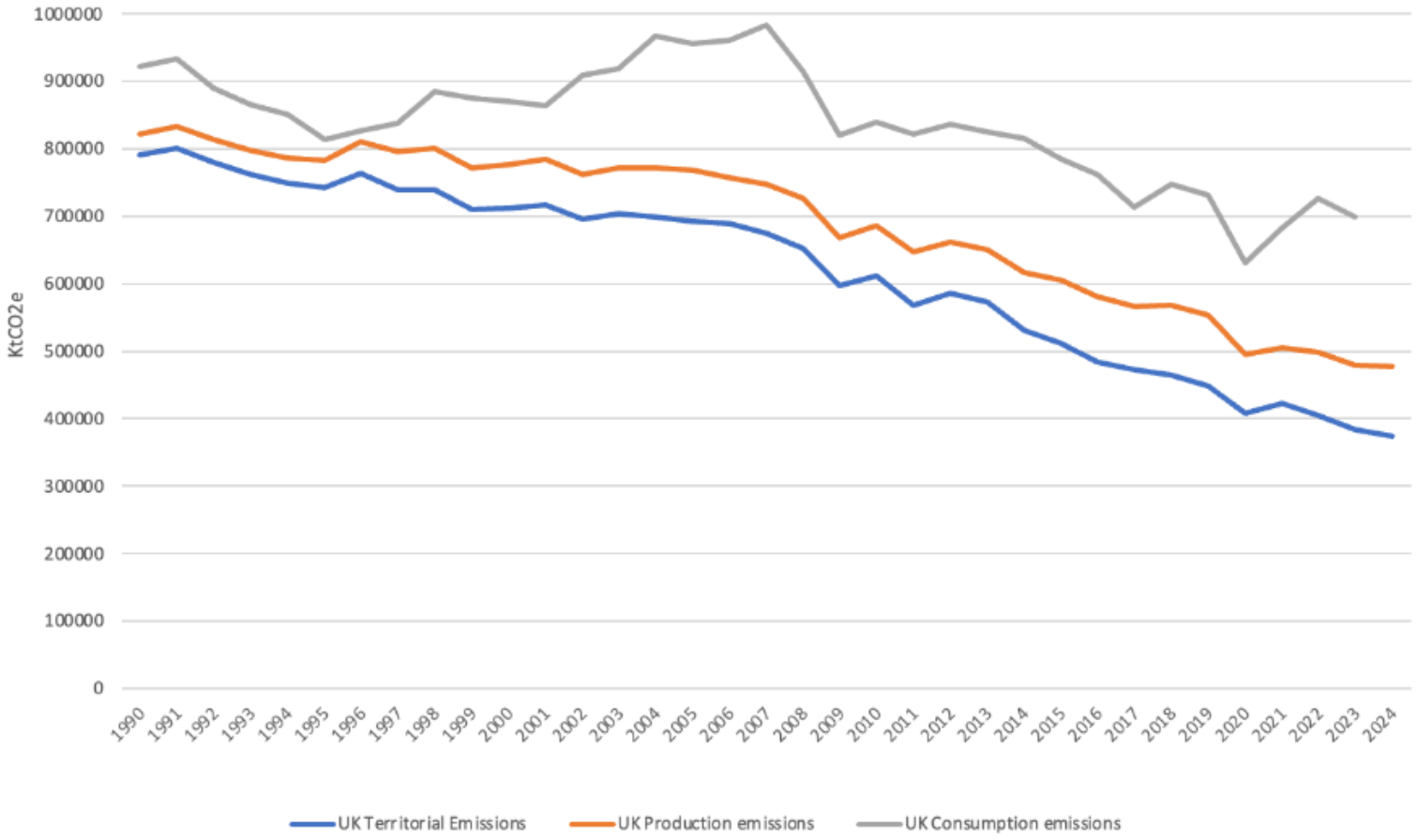
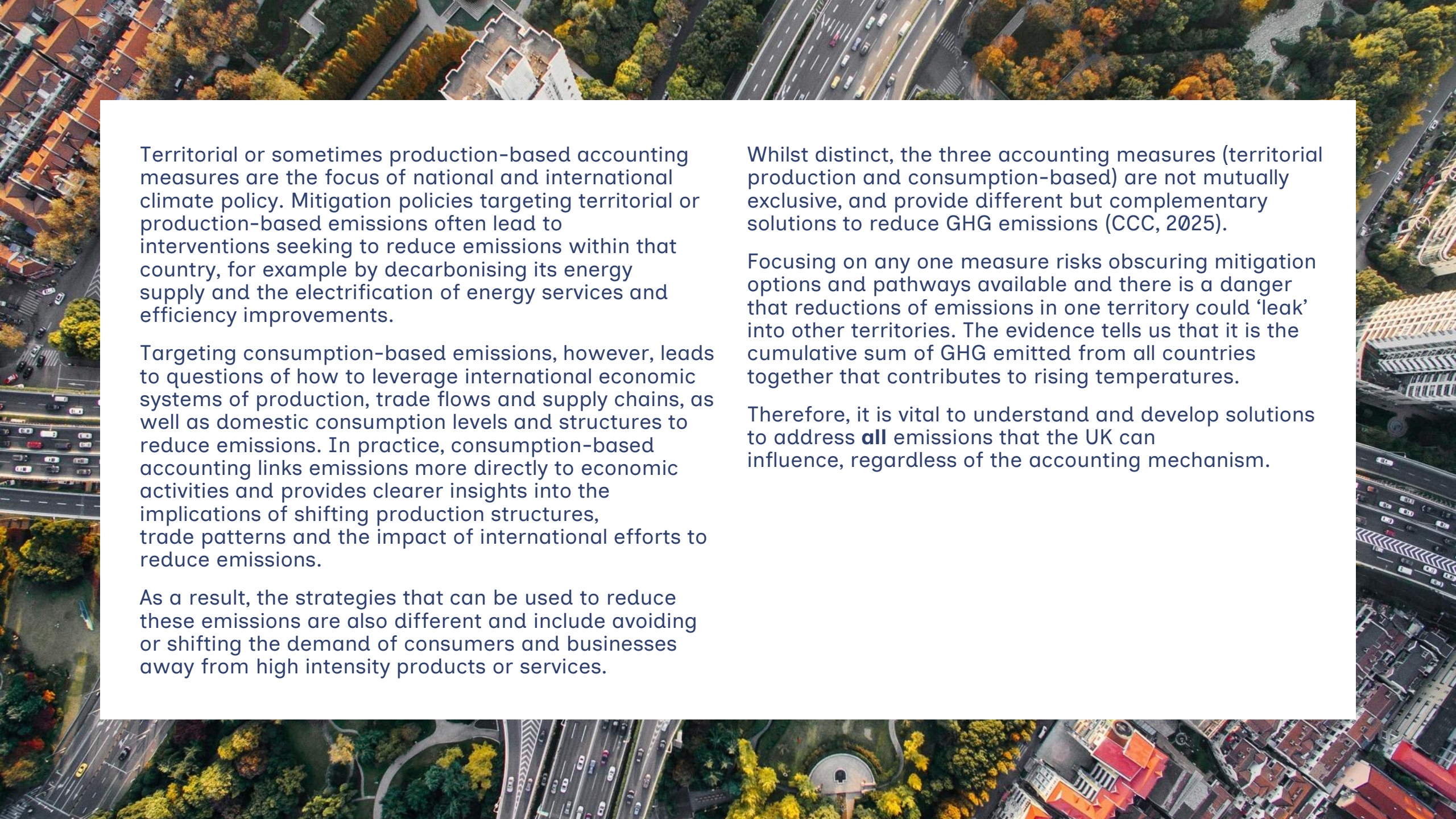


Figure 2: UK Territorial, Production and Consumption emissions (1990-latest data available) (Owen, 2026).



Territorial or sometimes production-based accounting measures are the focus of national and international climate policy. Mitigation policies targeting territorial or production-based emissions often lead to interventions seeking to reduce emissions within that country, for example by decarbonising its energy supply and the electrification of energy services and efficiency improvements.

Targeting consumption-based emissions, however, leads to questions of how to leverage international economic systems of production, trade flows and supply chains, as well as domestic consumption levels and structures to reduce emissions. In practice, consumption-based accounting links emissions more directly to economic activities and provides clearer insights into the implications of shifting production structures, trade patterns and the impact of international efforts to reduce emissions.

As a result, the strategies that can be used to reduce these emissions are also different and include avoiding or shifting the demand of consumers and businesses away from high intensity products or services.

Whilst distinct, the three accounting measures (territorial production and consumption-based) are not mutually exclusive, and provide different but complementary solutions to reduce GHG emissions (CCC, 2025).

Focusing on any one measure risks obscuring mitigation options and pathways available and there is a danger that reductions of emissions in one territory could ‘leak’ into other territories. The evidence tells us that it is the cumulative sum of GHG emitted from all countries together that contributes to rising temperatures.

Therefore, it is vital to understand and develop solutions to address **all** emissions that the UK can influence, regardless of the accounting mechanism.

What does the 2026 consumption-based emissions release tell us?

The three emissions accounting measures cover different scopes and use different methodologies. Consumption-based emissions are estimated using multiregional input-output analysis (MRIO). This means that industrial emissions are reallocated from the point of production to the point of consumption by tracing their path through supply chains to final demand.

We can trace supply chains across the globe; therefore, it is possible to calculate the total consumption-based account split by the source of emissions.

MRIO uses data from financial transactions which are well documented. Carbon emissions at each stage of the supply chain can then be estimated. For example, if steel from China is used to make a car in a factory in Germany and then it is transported to the UK where it is sold, the carbon emissions from the steel and manufacturing process will be included in the UK's consumption-based accounts.

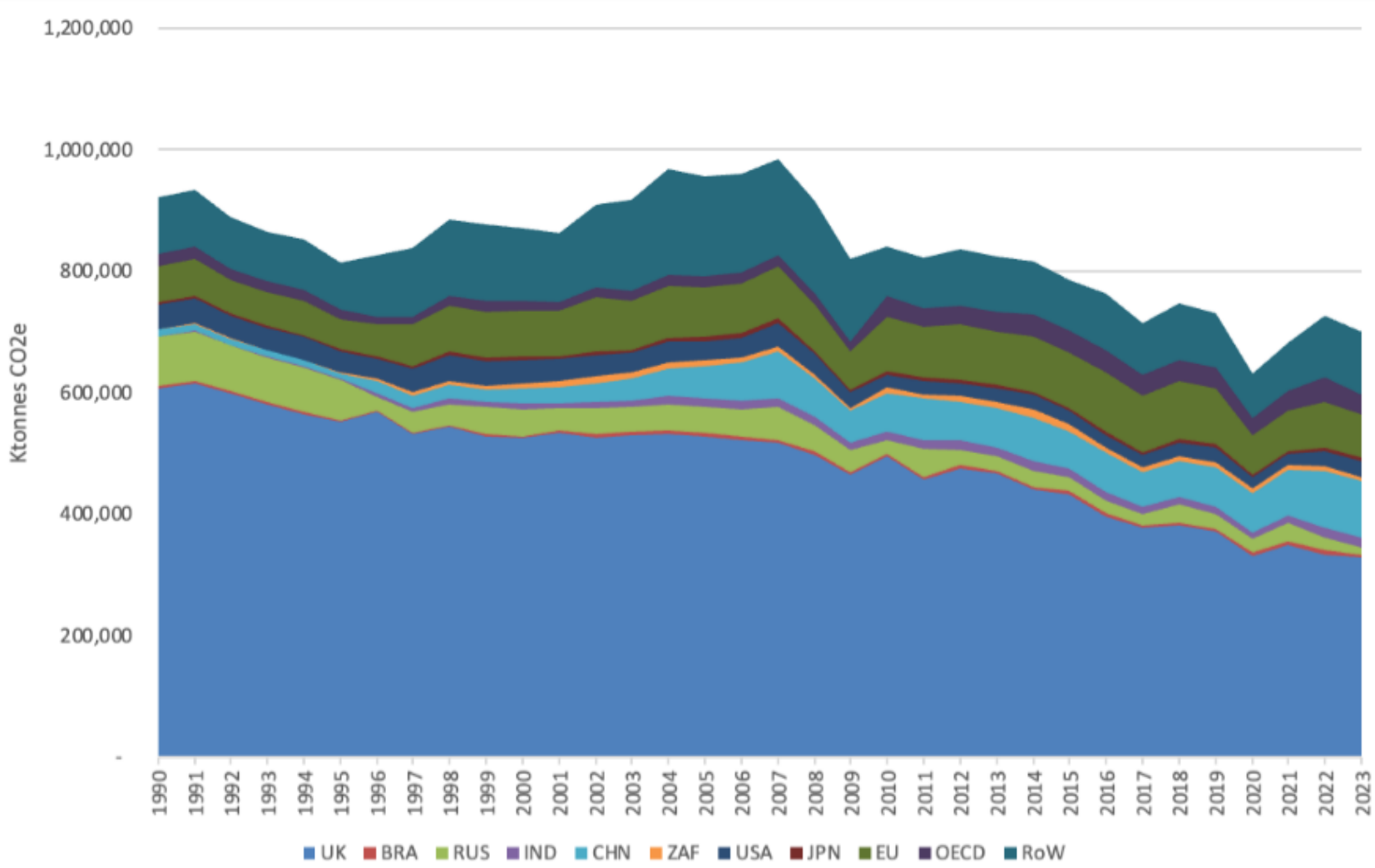
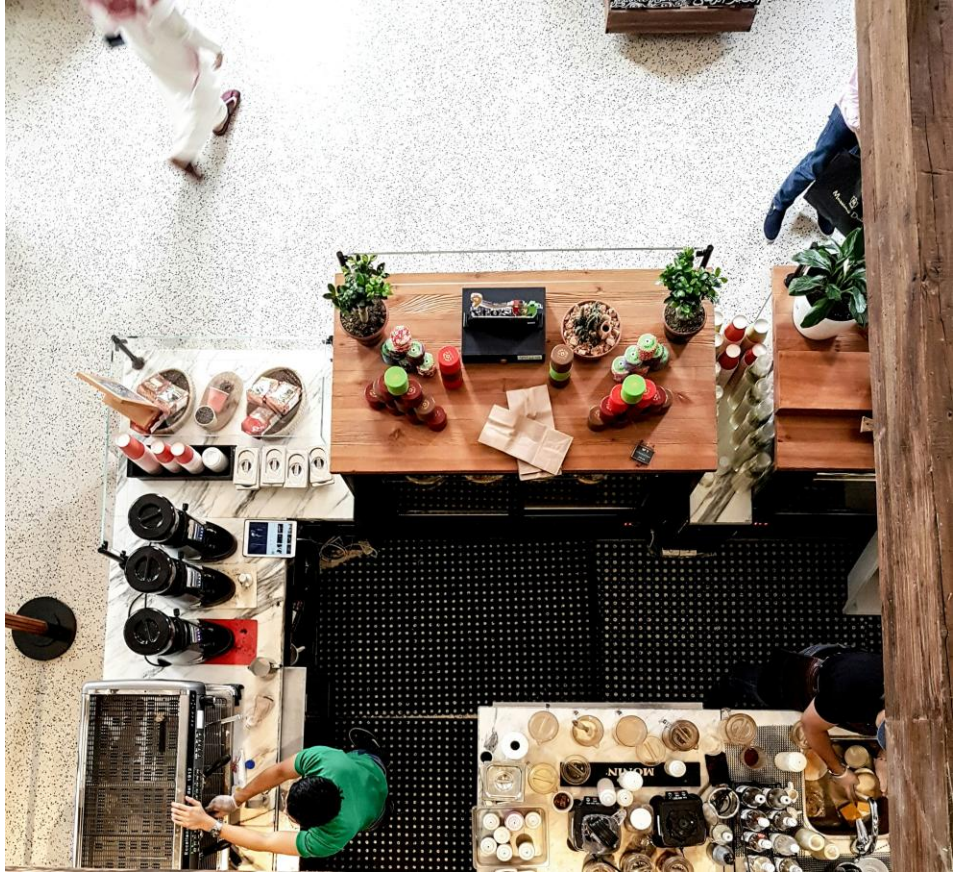


Figure 3: UK consumption-based emissions by source region (UK, Brazil, Russia, India, China, South Africa, USA, Japan, EU, Rest of OECD and Rest of World).

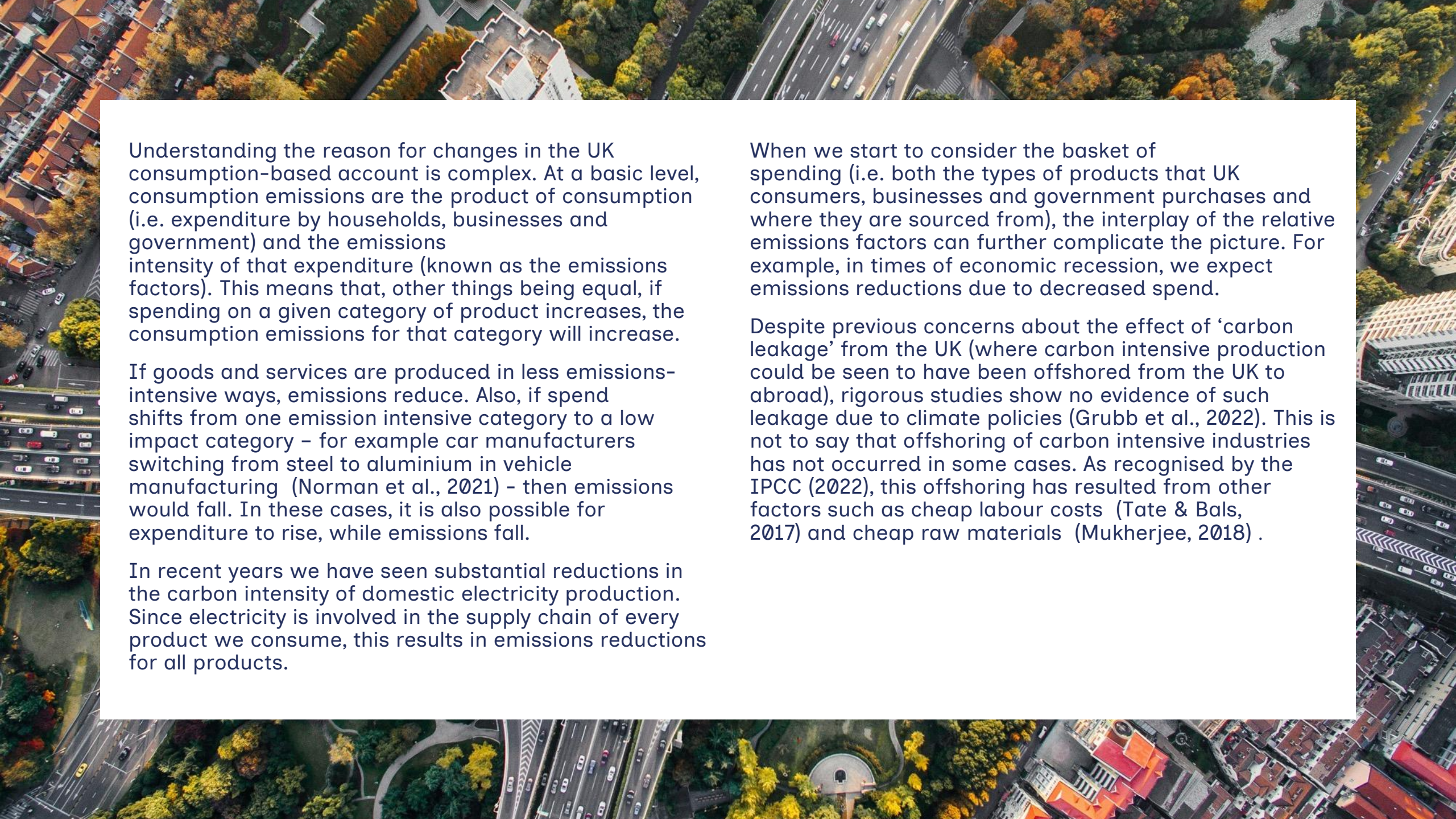
Based on the 2026 release shown in **Figure 3**, the UK's consumption-based emissions decreased by 12% between 1990 and 1995, before climbing to a peak of 984 million tonnes (Mt) CO_2e in 2007. The financial crisis saw a reduction of 17% to 2009, followed by a further 11% reduction between the years 2009 and 2019. The COVID-19 pandemic in 2020 saw a reduction of 14% in a single year, followed by a post pandemic rebound of 15% to 2022.

Between 2020 and 2022, consumption emissions fall due to restrictions on household activities during the COVID 19 lockdowns, only to bounce back above pre-COVID levels once the lockdowns were lifted. As a result, comparing 2022 with 2020, the GHG emissions associated with UK consumption increased by 96 $MtCO_2e$. Of this 96 $MtCO_2e$, increases in household spend on transport services, restaurants and hotels, and personal transport contributed the most to the increase. In 2023, the latest year available in the 2026 estimates, the UK's consumption-based GHG emissions have fallen by 4% from the previous year to 699 $MtCO_2e$. Overall, emissions estimates from consumption-based approaches closely mirror changes in the UK economy.

Figure 3 also shows the split between domestic and imported emissions for the UK's consumption-based emissions, with domestic emissions included at the bottom of the figure in blue, with imported emissions split by region of origin. It shows the share of imported emissions increasing from 34% in 1990 to 53% in 2023. This change in the share of imported emissions making up the UK's consumption-based emissions is primarily a result of the UK's success in reducing the emissions intensity of UK production. While total imported emissions rose immediately after the COVID lockdowns between 2020-2022, they fell at a faster rate than domestic emissions in domestic production in 2023.



What are the key drivers of the UK's consumption-based emissions?



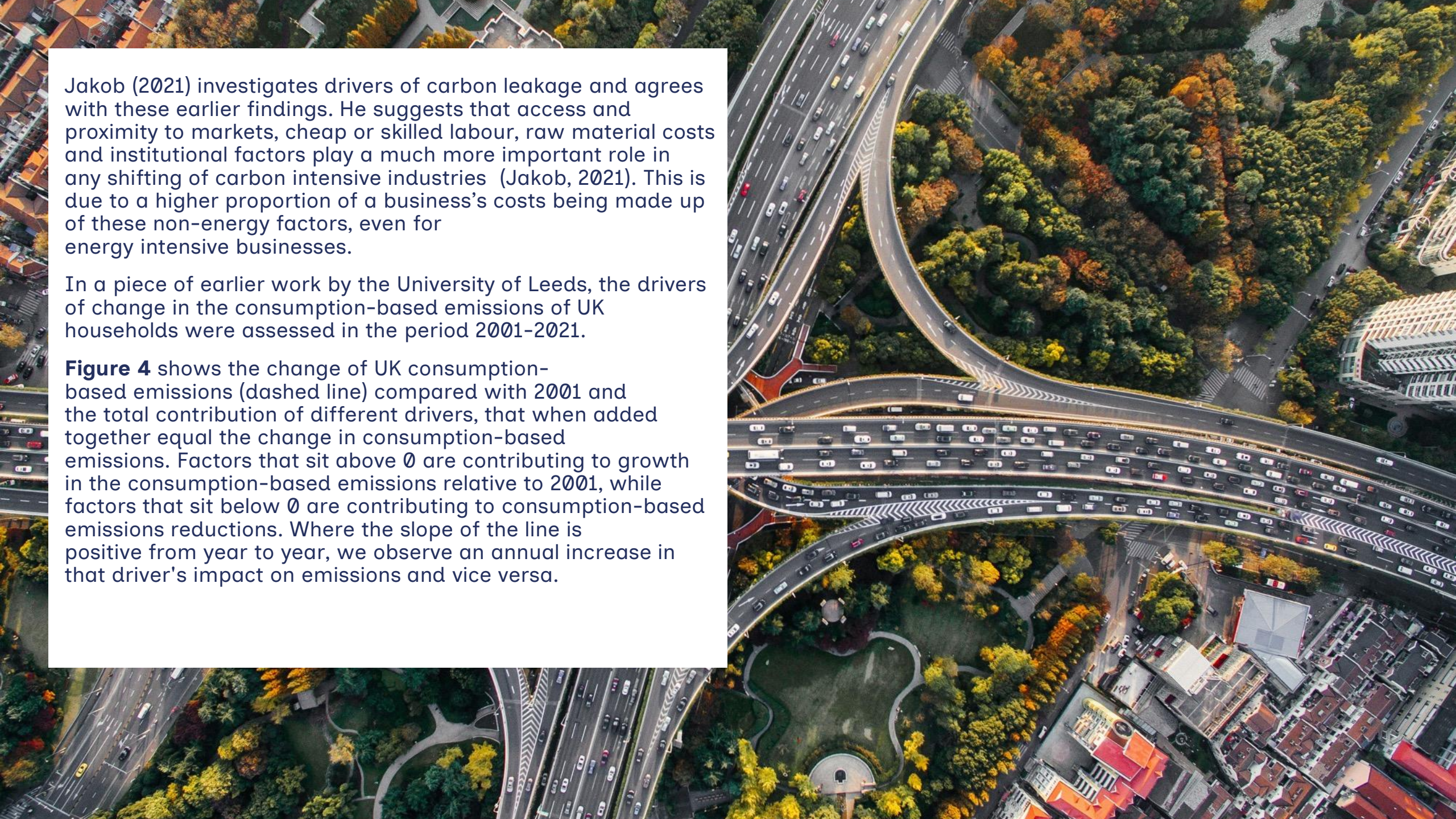
Understanding the reason for changes in the UK consumption-based account is complex. At a basic level, consumption emissions are the product of consumption (i.e. expenditure by households, businesses and government) and the emissions intensity of that expenditure (known as the emissions factors). This means that, other things being equal, if spending on a given category of product increases, the consumption emissions for that category will increase.

If goods and services are produced in less emissions-intensive ways, emissions reduce. Also, if spend shifts from one emission intensive category to a low impact category – for example car manufacturers switching from steel to aluminium in vehicle manufacturing (Norman et al., 2021) - then emissions would fall. In these cases, it is also possible for expenditure to rise, while emissions fall.

In recent years we have seen substantial reductions in the carbon intensity of domestic electricity production. Since electricity is involved in the supply chain of every product we consume, this results in emissions reductions for all products.

When we start to consider the basket of spending (i.e. both the types of products that UK consumers, businesses and government purchases and where they are sourced from), the interplay of the relative emissions factors can further complicate the picture. For example, in times of economic recession, we expect emissions reductions due to decreased spend.

Despite previous concerns about the effect of 'carbon leakage' from the UK (where carbon intensive production could be seen to have been offshored from the UK to abroad), rigorous studies show no evidence of such leakage due to climate policies (Grubb et al., 2022). This is not to say that offshoring of carbon intensive industries has not occurred in some cases. As recognised by the IPCC (2022), this offshoring has resulted from other factors such as cheap labour costs (Tate & Bals, 2017) and cheap raw materials (Mukherjee, 2018) .



Jakob (2021) investigates drivers of carbon leakage and agrees with these earlier findings. He suggests that access and proximity to markets, cheap or skilled labour, raw material costs and institutional factors play a much more important role in any shifting of carbon intensive industries (Jakob, 2021). This is due to a higher proportion of a business's costs being made up of these non-energy factors, even for energy intensive businesses.

In a piece of earlier work by the University of Leeds, the drivers of change in the consumption-based emissions of UK households were assessed in the period 2001-2021.

Figure 4 shows the change of UK consumption-based emissions (dashed line) compared with 2001 and the total contribution of different drivers, that when added together equal the change in consumption-based emissions. Factors that sit above 0 are contributing to growth in the consumption-based emissions relative to 2001, while factors that sit below 0 are contributing to consumption-based emissions reductions. Where the slope of the line is positive from year to year, we observe an annual increase in that driver's impact on emissions and vice versa.

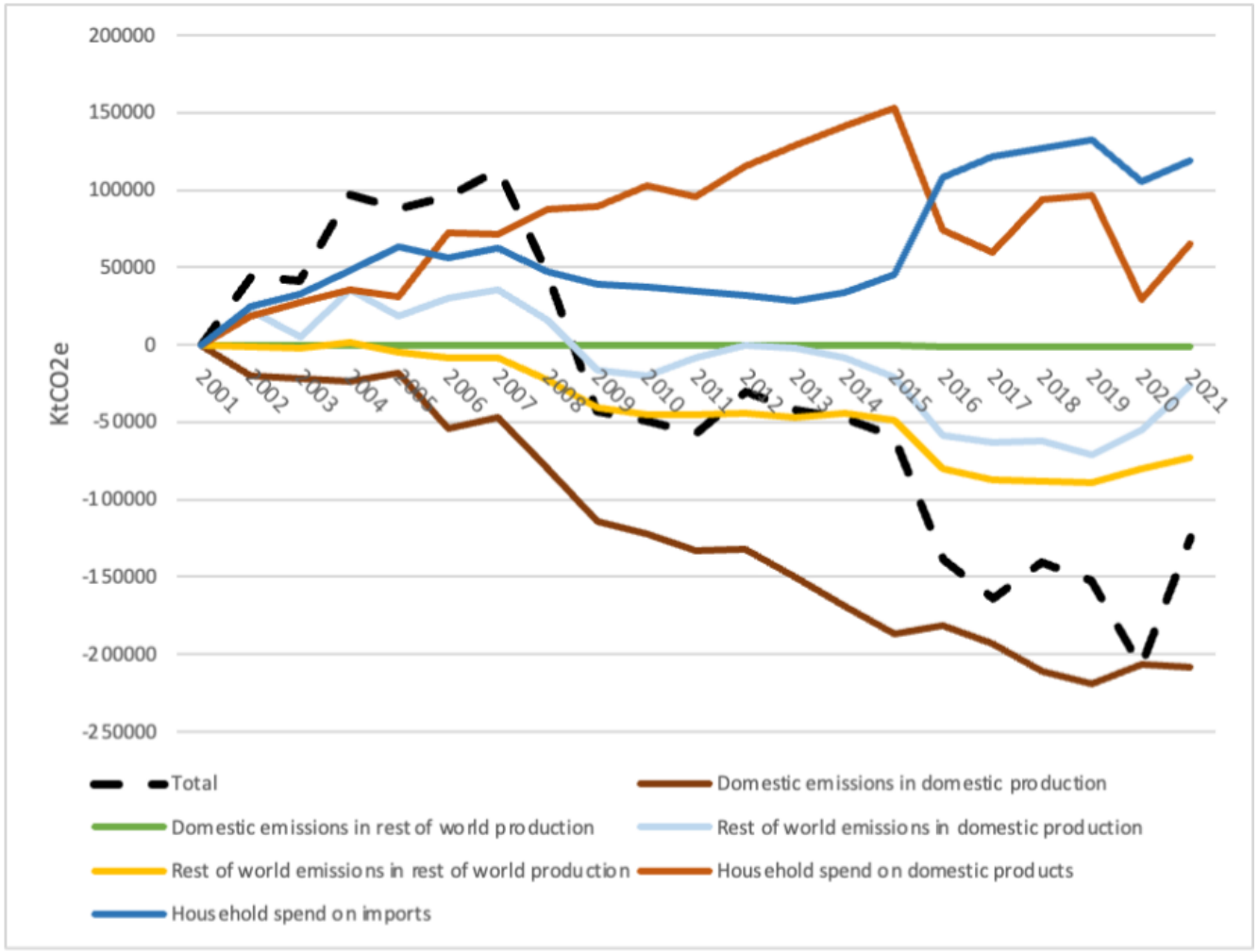


Figure 4: Decomposition analysis of drivers of changes in UK Consumption emissions 2001-2021. (indexed to 2001).

Household spending on imported goods (blue line) has contributed to consumption-based emissions growth. Comparing 2021 with 2001, demand for imports is the largest driver pulling emissions upwards. Comparing 2021 with 2015, the emissions resulting from spending on imports (blue) grows sharply, while those from demand for domestic goods falls (orange)[2].

The increased demand for imports is driving growth in imported emissions. At the same time, the emissions intensity of imported goods (yellow) is trending downwards across the time series, helping to reduce consumption-emissions and going some way to mitigate the impact of the growth in spending on imports.

From 2008 to 2015, this reduction in intensity was enough to ensure that total imported emissions to household consumption were declining. However, between 2015 and 2021, the growth in emissions from the demand for imports outstripped the reductions made in the emissions intensity of imports, causing total imported emissions to increase.

Looking at the other components of the consumption-based emissions, improvements in domestic production processes are the largest driver of decrease (brown) but UK reimports (green)[3], have a negligible contribution to the change in footprint.

Within the UKMRIO model we can distinguish the GHGs per £ spent for different products, when sourced from different countries. Depending on the type of product purchased, the associated emissions from imports can be smaller than domestically produced goods. This is often the case when we compare produce grown in heated greenhouses with produce that can be grown outside in countries with more suitable climates, even when accounting for increased transport requirements. Seasonality serves to further complicate the emissions factors for food.

Unpicking the drivers of changes in imported emissions is a complex task. While household expenditure on imported goods has been the main upward pressure on imported emissions at an economy wide scale, drivers on a product-by-product basis are likely to vary in type and number. PACT will continue to explore these drivers and produce more in-depth analysis to fully understand the underlying trends.

[2]This work focussed on the drivers of emissions associated with UK household's consumption. Although household consumption represents the majority, there are other parts of final demand, such as government spending on goods and service, which are not covered here.

[3] Re-imports are emissions embodied in exports that are then reimported to the UK.

Policy discussion: What are the options to reduce emissions?

All emissions reductions matter, whether produced in the UK or overseas, and the UK can develop strategies to reduce each. Understanding both territorial, production and consumption emissions can open more avenues for UK policy to influence emissions reduction both within the UK, and elsewhere in the world where they are associated with UK consumption.

Territorial emissions accounting is the predominant measure used within the United Nations Framework Convention on Climate Change (UNFCCC) and underpins international agreements on emissions reductions. This framework was agreed to avoid double counting emissions across different jurisdictions.

The UK's climate policy is based on territorial accounting, as per international norms and embedded in the domestic Climate Change Act. This means that UK government policies have predominantly centred around carbon budgets that target territorial greenhouse gas emission reductions, have contributed to a 54% reduction between 1990 and 2025 (DESNZ, 2026). This focus has led to the prioritisation of solutions that most impact territorial accounts, such as the decarbonisation of the UK's electricity system through the phasing out of coal and deployment of renewables within electricity generation.

As a result of the international framework, the UK is not alone in making significant progress in territorial emissions reductions. Territorial emissions accounting is also the predominant measure used within the United Nations Framework Convention on Climate Change (UNFCCC) and underpins international agreements on emissions reductions. **Figure 5** displays the relative emissions reductions targets of G7 countries compared with 1990 levels, indicating broad action to reduce emissions within advanced economies. This international climate action impacts our consumption-based emissions. As displayed by the yellow line in **Figure 4**, climate action elsewhere in the world helps to reduce the UK's imported emissions, as the GHG intensity of imported goods and services from other countries pursuing territorial emissions reduction is reduced.

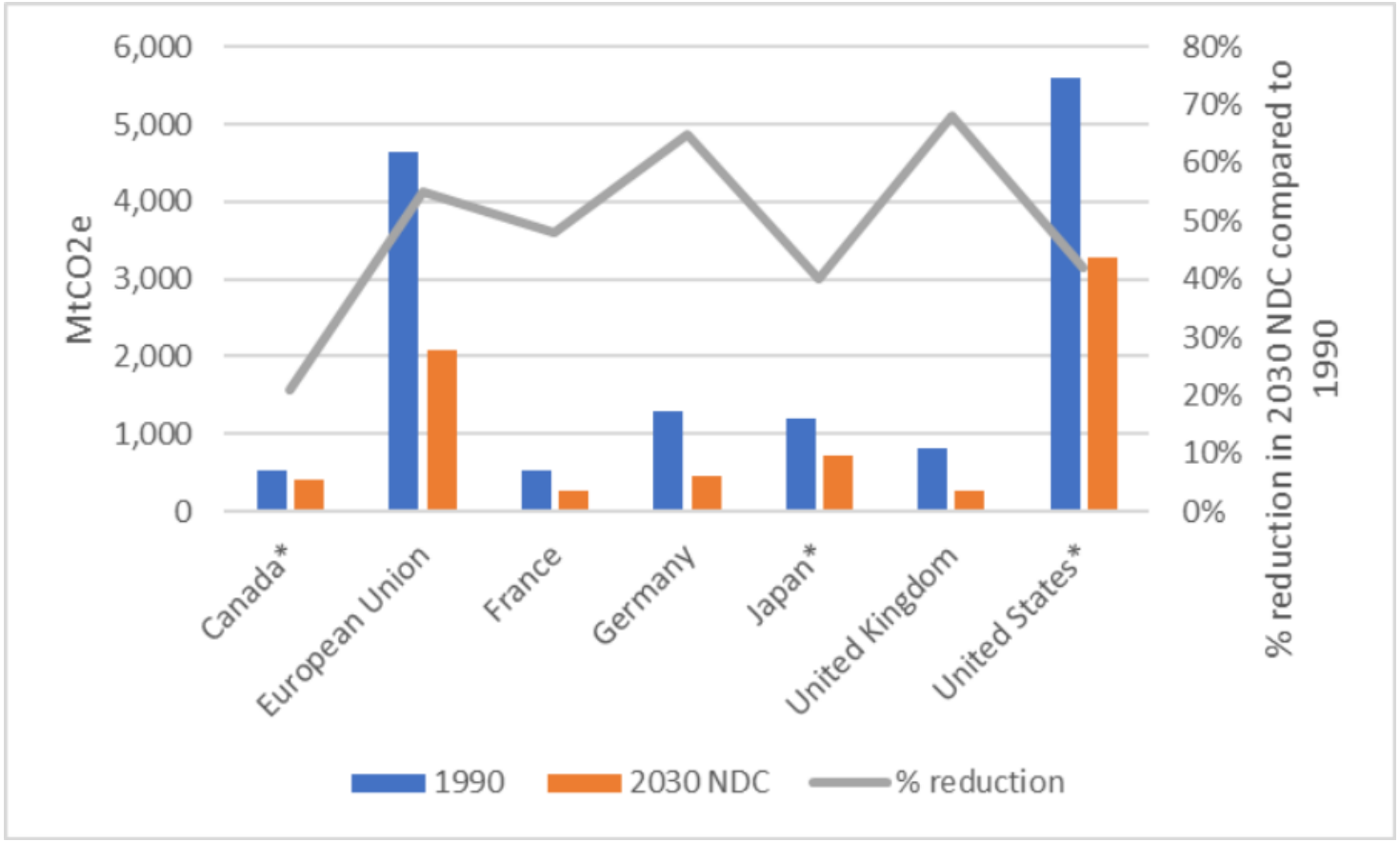
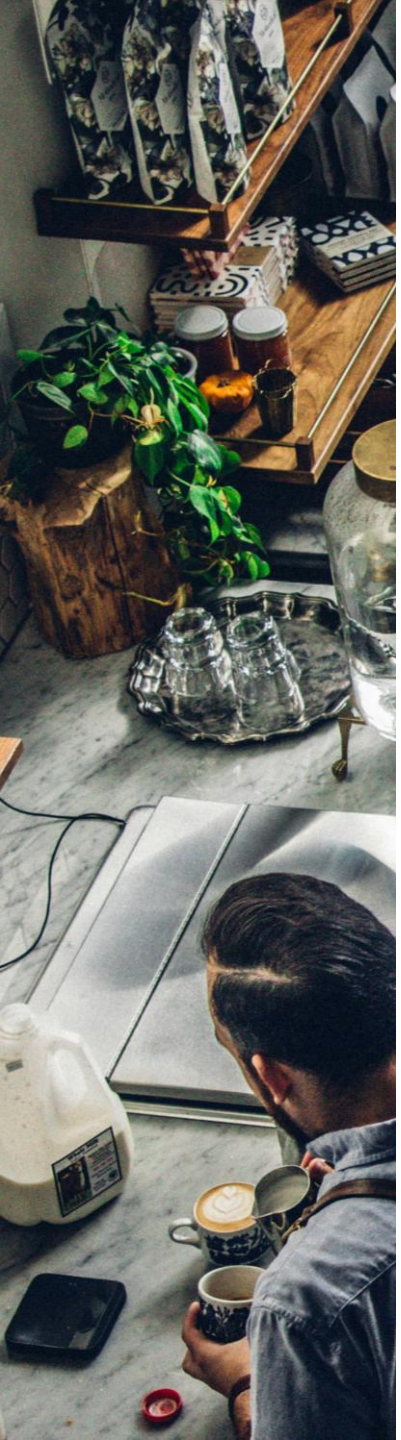


Figure 5: International territorial emissions (MtCO2e) comparison of G7 countries based on national reporting for 1990 and country emissions reduction targets set out in national climate legislation (France and Germany) or Nationally Determined Contributions (NDC)[4] (DESNZ, 2023). The left-hand vertical axis displays territorial emissions; the right-hand shows the relative percentage reduction in 2030 compared with 1990. (*) Indicates countries with a range of targets for 2030. A midpoint is taken and displayed in this figure.

[4] It is worth noting here that the USA's NDC is no longer operational due to their withdrawal from the Paris Agreement on 25th January 2025. Additionally, the accounting measures used to define national emissions, and their NDCs differ slightly. Germany's contribution to the EU's 2030 target excludes land-use emissions, however these emissions are included within the countries respective targets drawn from national climate legislation. Japan's emissions accounting uses a gross-net approach.



In addition to territorial accounting, developing a complementary focus on consumption-based emissions puts the spotlight on different strategies to reduce emissions in ways that can also meet economic and social goals. These strategies can directly reduce consumption-based emissions, particularly those that target reductions in energy demand, and the supply chains of the goods and services we consume. Recent evidence from France shows that policies that lower energy consumption can lead to an additional 1.4 tCO2e reduction in imported emissions for every 1 tCO2e of domestic emissions avoided (Fontaine et al., 2026).

These include policies that have featured in previous UK Net Zero Strategies, such as those explored in the *Unlocking Resource Efficiency* reports, (i.e. shifting to lower impact materials, extending the lifetimes of products through repairability, or shifting how products are consumed) (DESNZ & DEFRA, 2024). However, if we evaluate only the domestic emissions reduction potential of these measures, we underestimate the role that socio-economic transformation can play in driving emissions reductions globally.

There is growing evidence that energy demand reduction measures can also support the delivery of other key policy objectives, such as energy security, health, and wellbeing (Bento et al., 2024; Creutzig et al., 2022; Finn & Brockway, 2023). For example, Bento et al. (2024), find that demand-side interventions, such as the electrification of transport and small reductions in average thermostat temperatures make a higher impact on most energy security indicators than traditional supply-focused measures, such as increasing the production and use of renewable electricity to reduce reliance on imported fossil fuels.

Demand-side measures have also been found to be popular with citizens, especially where additional 'co-benefits' can be achieved. In are view of citizens assemblies' policy recommendations across Europe, energy demand reduction policies were disproportionately included when compared with national climate policy plans, gaining high approval rates among citizens (Lage et al., 2023). Recent research in the UK has found that citizens are strongly supportive of energy demand reduction measures and are willing to make changes to their everyday lives, provided that adequate supporting policies, investment and infrastructure are put in place (Yuille et al., 2026)(Yuille et al., 2026)[5]. These types of measures, with a clear social mandate, can make significant contributions to reducing both the UK's territorial and consumption-based emissions.

[5] Reference to project website. Full results of the EDRC Our Energy Futures citizens panel are due to be published in a forthcoming publication.

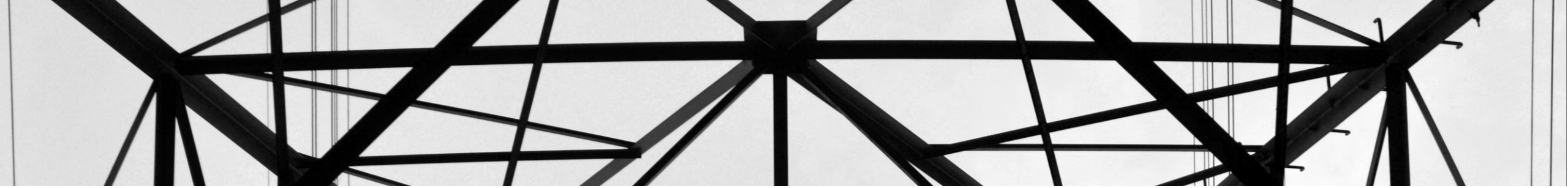
Conclusion

It is important to find ways to reduce all emissions that the UK can influence, regardless of how they are measured. By understanding territorial, production and consumption-based emissions, the UK can broaden the policy approaches relied upon to reduce emissions in the UK and in other countries that supply goods and services for UK consumers.
Whilst there has been significant success in reducing territorial emissions and in improving domestic production processes, the increase in demand for imports is continuing to place upwards pressure on consumption-based emissions.

Developing an additional focus on emissions linked to consumption, including energy demand and supply chains, can complement existing emissions reduction strategies and lead to a higher reduction potential overall, whilst potentially providing wider socio-economic benefits.

PACT will look to develop a more comprehensive understanding of the drivers of imported emissions over the coming months and strengthen the evidence base around consumption-based emissions and the associated mitigation opportunities.

Methodological annex: How accurate are the UK's consumption-based emissions figures?



MRIO provides an additional picture of GHG emissions which the UK can influence. Because it is more complete, it also introduces sources of uncertainty. These include:

- Assumptions made in choosing which source data is used to construct the model – which trade database best aligns with the UK national accounts?
- Choosing the technique used to align trade data with UK national accounts - how do we align different sector data measured in different currencies?
- Ensuring the model balances - data reported as imported to the UK needs to match the data exported from the trade partner's account. Mismatches are common.

Calculating consumption-based emissions accounts has only become possible in the last two decades and the datasets and techniques used are continually improving.

Figure 6 shows the evolution of the UK's consumption-based emissions measured in $MtCO_2e$ as calculated by the UK MRIO database. The overall pattern is very similar throughout the model versions. The new 2026 release estimates a very similar footprint compared to the 2025 release up until 2010, but data improvements in the 2026 released have increased estimates between 2010 and 2015 and reduced estimates between 2015 and the latest year. The reasons for these differences are due to an improvement in the way we calculate the proportion of imports.

There is some variation in model estimates of the consumption-based emissions account, but the general trend remains similar. We argue that while the reported UK consumption-based account contains uncertainty, we can be confident that the change over time is well understood and that the trend accurately portrays direction of travel. The consumption-based account can be used to demonstrate how well the UK is reducing the impact of both domestic emissions and emissions embodied in imports.

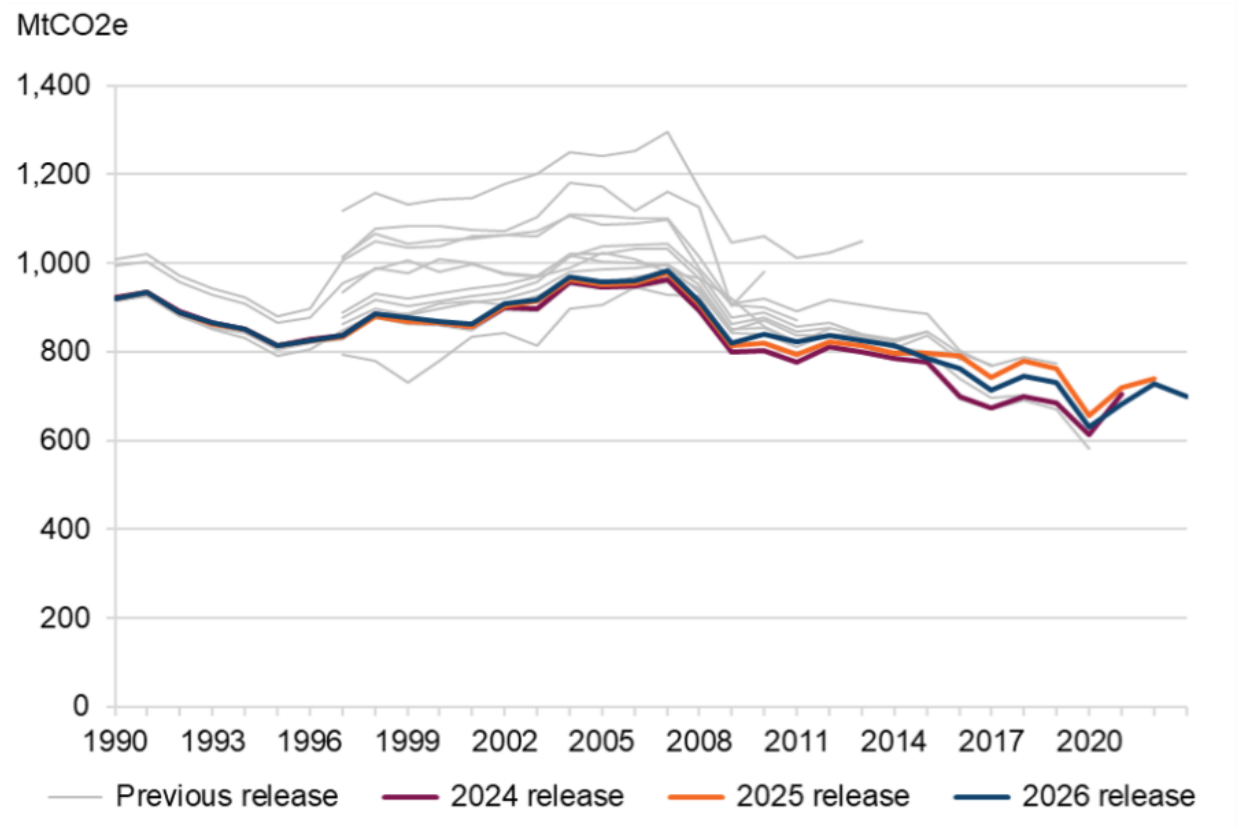


Figure 6: Results from the 2011 to 2026 releases of the UK consumption-based emissions account

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Thank you.

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