CONSUMPTION-BASED GREENHOUSE GAS HOUSEHOLD EMISSIONS PROFILES FOR LONDON BOROUGHS

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1 Introduction

In July 2019, London Councils Transport and Environment Committee (TEC) Executive agreed that London Councils should develop support for borough action on climate change, which was being accelerated by the passing of climate emergency declarations and the setting of new net zero targets at the council and borough level.

In December 2019, London Councils agreed a Joint Statement on Climate Change which sets out an overarching aim, to 'act ambitiously to meet the climate challenge that the science sets out, and find political and practical solutions to delivering carbon reductions that also secure the wellbeing of Londoners.' It also sets out seven priority areas for collaborative action, which are now being developed and led by a lead borough or boroughs, together with support from London Councils.

Reducing consumption-based emissions was identified as one of the priority areas, and a working group was established in mid-2020 to explore the issues and develop a draft action plan. The group's membership is drawn from the London boroughs and subject experts and was chaired by LB Camden, with London Councils and ReLondon (previously the London Waste and Recycling Board). The target set out for this area in the Joint Statement is to achieve a reduction of two-thirds, focussing on the areas of food, textiles, electronics, and plastics. Aviation is also potentially in scope as a theme to develop. From 1 April 2021 LB Harrow was appointed lead borough for this programme, which has been named 'One World Living – Reducing London's Consumption Emissions' in order to acknowledge the significant changes that we need to make as a society to learn to live better within the world's finite resources. London boroughs need a deeper understanding of consumption-based emissions to assist in developing the activities and focus areas in the action plan for the Consumption-based Emissions programme, and developing borough-level actions in line with the local context. The transport and household energy use data will also help inform the other London-wide climate programmes dealing with those areas, as identified in the Joint Statement on Climate Change. Boroughs are keen to both expand and communicate the evidence base to residents and other stakeholders.

In 2021, the University of Leeds was commissioned by London Councils and ReLondon to provide consumption-based greenhouse gas (GHG) household emissions profiles for the 32 London Boroughs and the City of London. This report documents the household consumption-based accounts (HCBA) for GHG emissions for the boroughs and the City of London for the period 2001-2018. A HCBA considers the emissions that occur due to the consumption activities of London residents, including all the emissions associated with the production of goods and services throughout their complete supply chain.

University of Leeds is responsible for producing the Consumption-based accounts (CBA) for the UK Government and the Greater London Authority (GLA) (Owen & Barrett, 2019). The same over-arching methodology has been applied to calculate the HCBA for the London boroughs and the City of London. This means that the sum of the household footprints for the 32 London boroughs and the City of London will equal the emissions associated with household consumption reported by the GLA pan-London. The predominant methodology is an "Environmentally Extended – Multi Regional Input Output" model (EE-MRIO). This has become the standard approach to assess the consumption-based emissions of a country or region. EE-MRIO is the most comprehensive, versatile and compatible approach for consumption-based accounting of greenhouse gas emissions and has become the norm (Davis & Caldeira, 2010; Hertwich & Peters, 2008; Peters et al., 2011).

The UK has adopted consumption-based emissions as an Official Statistic (UK Government, 2021) and has undertaken numerous reports that employ the approach to evaluate the effectiveness of climate mitigation measures beyond technological solutions.

1.1. Scope of the project

The emissions profiles reported will be the emissions associated with household consumption by residents of each of the boroughs and the City of London. This means that emissions associated with consumption by local and regional government and emissions associated with capital expenditure are not included. It is also important to understand that the emissions profiles are not a measure of the emissions associated with businesses in the borough or traffic flows. The profiles are solely emissions associated with consumption of goods and services by residents and those direct emissions from residents' fuel burning from private cars and homes. Emissions from local businesses are only reflected in the total if the goods sold are purchased by London residents and traffic emissions are only included if the driver is a local resident or the emissions are from the transportation of goods or services that are consumed by local residents.

1.2. Structure of the report

Section 2 provides definitions of the three ways GHG emissions can be allocated to a region: territorial-based, production-based and consumption-based and gives information on what is included and excluded in the account. Section 3 is an overview of the methods and datasets used for this project. The results are presented in Section 4. This section aims to briefly introduce the high-level results, followed by a deep-dive into the results for a single borough with guidance as to how to interpret the findings. The report concludes with recommendations and next steps.

2 Definitions

GHG emissions can be allocated to a country or region in different ways: (I) territorial-based, (II) production-based, and (III) consumption-based emission reporting.

2.1 Territorial Emissions

The United Nations Framework Convention on Climate Change (UNFCCC) requires (Annex I and/or national governments that are Parties to the UNFCCC and/or the Kyoto Protocol) countries to submit annual National Emission Inventories. These inventories are used to assess the progress made by individual countries in reducing GHG emissions. The UNFCCC follows the Intergovernmental Panel on Climate Change's (IPCC) Guidelines for National GHG Inventories which is, "emissions and removals taking place within national (including administered) territories and offshore areas over which the country has jurisdiction" (IPCC, 2007). According to this definition, however, GHG emissions emitted in international territory, international aviation and shipping, are only reported as a memo and not allocated to individual countries. In the UK, the Department for Business, Energy and Industrial Strategy (BEIS) reports these emissions as the UK's Greenhouse Gas Inventory and they form the basis for reporting on progress towards our domestic and international emissions reduction targets. In this report, we call this account "**territorial-based emission inventories**".

2.2 Production Emissions

In official reporting to Eurostat[1], GHG emissions are allocated in a consistent manner to the system boundary for economic activities such as the Gross Domestic Product (GDP) used in the System of National Accounts (SNA). This boundary reporting is known as the residence principle. In the SNA, international aviation and shipping are typically allocated to countries based on the operator of the vessel. Particularly in Europe (Eurostat), these inventories are often known as "National Accounting Matrices including Environmental Accounts (NAMEAs)". In the UK, the Office for National Statistics (ONS) publishes this account as part of the UK Environmental Accounts. The figures represent emissions caused by UK residents and industry whether in the UK or abroad, but exclude emissions within the UK which can be attributed to overseas residents and businesses and those emissions from Land use, Land Use Change and Forestry. In this report, we call these "**production-based emission inventories**".

2.3 Consumption Emissions

Consumption-based emissions allocate emissions to the consumers in each country, usually based on final consumption as in the SNA but also as trade-adjusted emissions (Peters, 2008). Conceptually, consumption-based inventories can be thought of as consumption equals production minus exports plus imports (see Figure 1). Consumption-based emissions do not have to be reported officially by any country, but they are increasingly estimated by researchers (see review by Wiedmann 2009). In the UK, the Department for Environment, Foot and Rural Affairs (Defra) publishes the consumption-based emissions calculated by the University of Leeds. In this report, we call these "**consumption-based emission inventories**" or "the Carbon Footprint".

Table 1 provides a simplified view of what is included and excluded in each emissions account.

[1] The statistical office of the European Union

Table 1: Types of emissions inventory included in UK territorial, production and consumption accounts. Green indicated inclusion and red indicates exclusion. RoW = rest of world

Emissions from…	UK Territorial	UK Production	UK Consumption
industries owned by UK, located in UK making products consumed by UK	Green	Green	Green
industries owned by UK, located in UK making products consumed by RoW	Green	Green	Red
industries owned by RoW, located in UK making products consumed by UK	Green	Red	Green
industries owned by RoW, located in UK making products consumed by RoW	Green	Red	Red
industries owned by UK, located in RoW making products consumed by UK	Red	Green	Green
industries owned by UK, located in RoW making products consumed by RoW	Red	Green	Red
industries owned by RoW, located in RoW making products consumed by UK	Red	Red	Green
industries owned by RoW, located in RoW making products consumed by RoW	Red	Red	Red
bunker aviation & shipping owned by UK and used by UK residents	Red	Green	Green
bunker aviation & shipping owned by RoW and used by UK residents	Red	Red	Green
bunker aviation & shipping owned by UK and used by RoW residents	Red	Green	Red
bunker aviation & shipping owned by RoW and used by RoW residents	Red	Red	Red
UK citizens' activities within UK territory	Green	Green	Green
RoW citizens' activities within UK territory	Green	Red	Red
UK citizens' activities within RoW territory	Red	Green	Green
RoW citizens' activities within RoW territory	Red	Red	Red
land use, land use change and forestry	Green	Red	Red

2.4 Composition of the GHGs

For the 2021 release of the UK consumption-based account we are able to include the full suite of GHGs as reported to the UNFCCC. These are:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydro-fluorocarbons (HFC)
- Perfluorocarbons (PFC)
- Nitrogen trifluoride (NF_3)
- Sulphur hexafluoride (SF_6) all measured in kilotonnes CO_2e

This means that the HCBA for the London Boroughs and the City of London will also contain this full suite of GHGs.

3 Methodology and data sources

3.1 Overview of the EE-MRIO methodology

Input-output models (IOM) have been adopted by environmental economists due to their ability to make the link between the environmental impacts associated with production techniques and the consumers of products. An environmentally-extended multiregional input-output model (EE-MRIO) uses matrix algebra to transform production-based emissions from industries anywhere in the world to the point of consumption. This means it is possible to calculate the consumption-based emissions of nations which take into account the GHGs from full supply chain of production, regardless of where in the world production stages took place. Once the nation's CBA is calculated, the emissions associated with smaller geographies can be determined.

For further detail on the mathematics used in input-output analysis, see the Appendix.

3.2 Data sources

This project will use the University of Leeds' UKMRIO model (Owen & Barrett, 2020; Owen et al., 2018) but the data on household final demand for each of the London boroughs and the City of London will need to be constructed. We need to calculate what proportion of the total London household spend each of the individual London administrative areas is responsible for, for each consumption item contained in the database. For example, if households in Harrow spend 30 per cent of the total London household spend on clothing, it will receive 30 per cent of the total London household footprint associated with clothing. To understand the portion of London households' spend by product attributed to each administrative area we will use two approaches:

Firstly, for domestic consumption of gas and electricity we will use the 'Regional and local authority consumption statistics' produced by BEIS which give estimates of gas and electricity consumption at the Local Authority level for Great Britain for the years 2005-2019. We will convert the data into proportions (i.e., what proportion of the total gas and electricity use for London is each administrative area using) and use trend projections to project the data back to 2001. Home energy use represents around ¼ of a household's consumption-based emissions account and so using data on real energy use is an advantage and will lead to a more accurate estimate of household consumption-based emissions.

Secondly, for all other consumption, we will construct unique spend profiles using the Living Costs and Food Survey (LCFS) and the census output area classification (OAC) for each of the 32 London boroughs and the City of London.

3.3 Using the LCFS and the OAC to construct borough spend profiles

Since 1957, the Office for National Statistics (ONS) has annually surveyed UK households on their weekly expenditure (UK Data Service, 2019). In 2008 this survey became known as the Living Costs and Food Survey (LCFS). The LCFS achieves a sample of around 6,000 UK households and is used to provide information on retail price indices, National Account estimates of household expenditure, the effect of taxes and benefits, and trends in nutrition. In addition to providing information on household spend on over 300 different product types (coded by the European Standard Classification of Individual Consumption by Purpose (COICOP)), further information is collected such as the age, sex and occupation of members of the household, the total household income, the Government Office Region they reside in and the household classification of the census output (OAC). The characteristics of each sampled household are compared to the characteristics of all UK households using the UK census. The survey strives to produce a representative sample of the 27 million UK households. For each of the 5000+ household surveys in the 2018 release, a weight is supplied to indicate the proportion of UK households that are represented by this profile. For example, the 1st household in the 2018 survey has a weight of 4,576 meaning that 4,567 households in the UK are represented by this single survey. The sum of every weight is 27 million – the total number of households in the UK. The LCFS is available in a format that is comparable for the years 2001-2018. This means that results for the devolved regions and administrative districts below this level start from 2001.

Since the LCFS collects information on the household's Government Office Region, we can easily construct a spend profile for all households in London. We then calculate the proportion of spend by product that London spends compared to the UK total. Multiplying these proportions by total UK footprint by product disaggregates the consumption-based GHG emissions for the UK down to the London level. This method ensures that the sum of the regions equals the total footprint. We do not have locational information on the borough where the surveyed households live, so we cannot simply follow this method to calculate our borough level HCBAs.

3.3.1 The OAC hierarchy

To construct spend profiles for the London boroughs and the City of London, we use the output area classification (OAC) data recorded in the LCFS. The OAC is the ONSs' free and open geodemographic household segmentation. The OAC provides "summary indications of the social, economic, demographic, and built characteristics" of the census Output Areas of the UK (Gale et al., 2016, p1). The OAC is constructed using datasets from the UK Census and there have been two versions of the classification: one that classifies the 2001 output areas using data from the 2001 census (Vickers & Rees, 2007) and one which classifies the 2011 output areas using data from the 2011 census (Gale et al., 2016).

Geodemographic classifications use mathematical clustering algorithms to generate groupings such that the differences *within* any group are less than the difference *between* groups. Once a set of groups is generated, the creators of the classification system name the individual groups based on features of the profile and write short "pen portrait" descriptions of them (Gale et al., 2016). Vickers & Rees (2007, p399) describe the naming process as "difficult and perilous" and note that some names appear to be contentious, particularly when describing what could be perceived as negative characteristics. However, Gale et al. (2016, p15) point out that the process "help[s] end users to identify with the names and description given to local areas" and that the "descriptors had strong and literal links to the underlying distributions revealed by the data". The 2001 and 2011 OAC classification names can be found in the appendix.

Both OACs follow a three-tier classification of supergroups, groups and subgroups (see Table 2). For example, the 2011 supergroup type 5 is Urbanites, the group type 5a is Urban professionals and families and the subgroup type 5a3 is Families in terraces and flats.

Table 2: Properties of the 2001 and 2011 OAC

	2001 OAC	2011 OAC
Number of supergroups	7	8
Number of groups	21	26
Number of subgroups	52	76

The LCFS records the 2001 OAC type in the survey years 2008-2013 and the 2011 OAC type in the survey years 2014-2018. No OAC type is recorded in the LCFS for the years 2001-2007. Using the LCFS, we generate average spends profiles for each classification type (for the supergroups, groups and subgroups) by summing the surveys that are characterised by each OAC type and dividing the product spends by the total weights assigned to these surveys – essentially producing an average spend by product by household OAC type. We do this for each year to reflect the fact that an OAC type will change its spend pattern over time. For the years 2001-2007, the spend profiles for 2008 are used as a proxy. If we know the number of households of each type recorded in each borough, we can produce a total spend profile for the borough. We then work out the proportion that the borough spends compared to the total for London. This method ensures that the sum of the boroughs plus the City of London equals the total footprint of the GLA.

To ensure that the spends captured for the London boroughs truly reflect the character of spends of London households, rather than use the complete LCFS to generate spend profiles by OAC type, we first isolate only those surveys found in London. This means that instead of profiling the spend of a '3c2 Constrained Commuter' we are generating the profile of a 'London 3c2 Constrained Commuter'. By restricting the surveys to the London surveys, we risk having too few surveys for a representative sample of households classified as '3c2' (for example). The number of surveys in the LCFS from London households ranges from 678 in 2001 to 407 in 2014.

To solve the issue of having too few surveys for a representative sample of certain OAC types, we use a hierarchical decision tree to generate the spend profiles by OAC type. If we take the subgroup 'London 3c2 Constrained Commuter' as an example OAC type, if there are 20 or more household surveys of this type, the average spend for 'London 3c2' is recorded. If there are fewer than 20 observations, we move up the classification tree to the group 'London 3c Ethnic Dynamics'. If there are 20 or more observations for this type, any households with the classification type 3c2 will be given the expenditure profile of type 3c. Otherwise, we move to the supergroup 'London 3 Ethnicity Central' and follow the same logic. Finally, if there are fewer than 20 observations at the supergroup level, the households classified as 3c2 would be given the London average spend profile (see Figure 1).

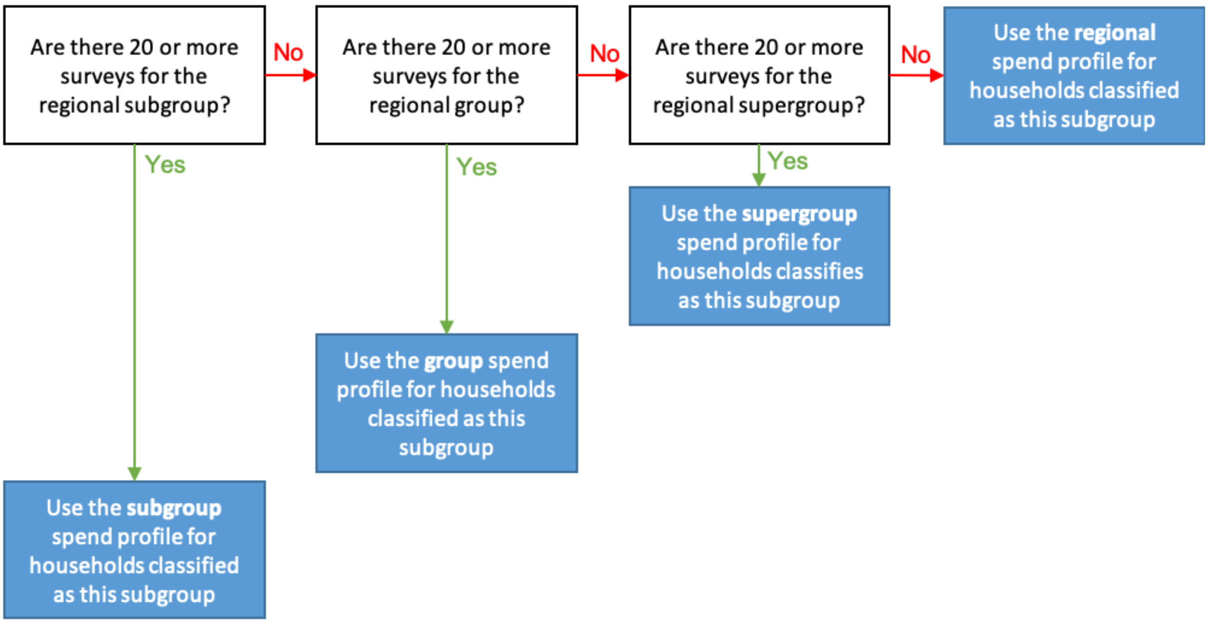


Figure 1: Hierarchical decision tree for assigning spend profiles

Table 3 shows a record of the 2011 OAC subgroups found in Harrow in 2018 and whether the profile from the subgroup was used or whether it was replaced with a group, supergroup or regional average spend profile. In the 2018 LCFS there were 25 surveys from households living in London output areas classified as 3a2 Young families and students and this was deemed to be a sizable sample to create a spend profile for this subgroup. However, there were only 17 surveys from London households classified as 3a1 Established renting families. For type 3a1, the group 'London 3a Ethnic family life' was used as a proxy spend profile because once we reached this level in the OAC hierarchy, there were 42 surveys in the 2018 LCFS.

Table 3: Example of the 2011 OAC subgroups found in Harrow in 2018 and the substitution OAC Group or Supergroup used if needed

Subgroup Code	OAC name	OAC code used	OAC name used
2a1	Student communal living	2	Cosmopolitans
2c1	Comfortable cosmopolitan	2	Cosmopolitans
2d1	Urban cultural mix	2d	Aspiring and affluent
2d3	EU white-collar workers	2d	Aspiring and affluent
3a1	Established renting families	3a	Ethnic family life
3a2	Young families and students	3a2	Young families and students
3b1	Striving service workers	3b1	Striving service workers
3b3	Multi-ethnic professional service workers	3b3	Multi-ethnic professional service workers
3c1	Constrained neighbourhoods	3	Ethnicity central
3d1	New EU tech workers	3d	Aspirational techies
4a3	Commuters with young families	4a3	Commuters with young families
4b1	Asian terraces and flat	4b1	Asian terraces and flat
4c1	Achieving minorities	4c	Asian traits
4c2	Multicultural new arrivals	4c2	Multicultural new arrivals
4c3	Inner city ethnic mix	4c3	Inner city ethnic mix
5a2	Multi-ethnic professionals with families	5a	Urban professionals and families
5a3	Families in terraces and flats	5a	Urban professionals and families
5b1	Delayed retirement	5	Urbanites
5b2	Communal retirement	5	Urbanites
6a1	Indian tech achievers	6	Suburbanites
6b1	Multi-ethnic suburbia	6	Suburbanites

3.3.2 Generating estimates of population by year, OAC and administrative region

Alongside estimates of the spend profiles by OAC types, we need to know how many households are of each type in each of the London Boroughs and the City of London for each year. 2001 was a Census year and each of the output areas (OA) in London was classified as one of the 52 different OAC types. It is possible to record the population and number of households by OA and link the 2001 OAs to higher level geographies such as the 2018 local authorities (which includes the 32 London boroughs and the City of London). Similarly, there is population and number of households data for 2011 from the 2011 Census. The issue is that we need to be able to estimate the population or number of households by OAC types, by borough, for the years 2002-2010 and 2012-2018.

For the years 2002-2013, it was only possible to find population estimates at the local authority level. This growth rate in population can be applied to the number of households by OAC from 2001 to estimate the mix of household types by borough and the City of London. For these years we have to assume that household occupancy remains stable (the population per households) and we assume that if the population of a borough grew by 5%, the households classified by each OAC type grew at exactly the same rate. The mix of OAC types remains in the same proportion as observed in 2001. We are also assuming that the classification type assigned to an output area (OA) in 2001 is still relevant in 2013. We assume that the character of the individual OA has not changed.

For the years 2014-2018, population estimates are available at the output area level. This means we can observe varying growth rates by OAC type since some OAs might grow faster than others within a borough. However, we are still making the assumption that the classification type assigned in the 2011 census is relevant in 2018. Again, we assume that the character of the individual OA has not changed and that household occupancies by OAC type are constant over the time period.

Now we have annual estimates of number of households by OAC by borough and annual estimates of spend by households by OAC type. Multiplying the two together gives a total spend by product by borough. Table 4 summarises the datasets and methods used to generate the spend profiles for the boroughs and the City of London. A traffic light system is used to indicate the reliability of the datasets and methods. It is then a simple step to work out the proportion of the total London spend by product that each borough is responsible for and apply these proportions to the GLA HCBA to produce the HCBAs for the 32 boroughs and the City of London.

Table 4: Summary of datasets and methods used to generate spend profiles for the boroughs and the City of London

	OAC classification type used	OAC spend data	Population by OAC type and borough
2001	2001 OAC	Take OAC spend proportions from 2008 but match to 2001 London spends	Take household figures by OAC from 2001 census and sum to borough level
2002-2007	2001 OAC	Take OAC spend proportions from 2008 but match to 2002-2007 London spends	Take household figures by OAC from 2001 census and sum to borough level. Then use ONS dataset[2] on population change by LA level to calculate annual growth rate in households from a 2001 baseline. Apply this same percentage change to each OAC type in each LA.
2008-2013	2001 OAC	Annual spend profiles available in the LCFS	Take household figures by OAC from 2001 census and sum to borough level. Then use ONS dataset on population change by LA level to calculate annual growth rate in households from a 2001 baseline. Apply this same percentage change to each OAC type in each LA.
2014-2018	2011 OAC	Annual spend profiles available in the LCFS	Take household figures by OAC from 2011 census at the OA level. Use ONS dataset[3] on population change by OA for 2014-2018 to estimate number of households by OAC in the LAs

[2] MYEB3_summary_components_of_change_series_UK_(2018_geog19).csv. We are aware that the GLA has their own estimates of population change by London borough which differ from the ONS figures but we aim to use a national dataset to ensure consistency with other data from the ONS and to match the population data used from the ONS from 2014-2018

[3] mid-2014-2018-coa-unformatted-syoa-estimates-london.xlsx

4 Results

4.1 High level results

The household consumption-based account for London has decreased from 101 Mtonnes CO2e in 2001 to 74 Mtonnes CO2e in 2018 – a reduction of 27 per cent (Figure 2). Note there is no key as this chart is illustrative of the overall pattern. This reduction is in line with reductions seen at a national level and is mainly due to decarbonisation of the electricity sector reducing the emissions intensity of products bought. Some of the reduction is due to reduced spend post-recession and an increased reliance on domestically produced goods rather than imports post-recession.

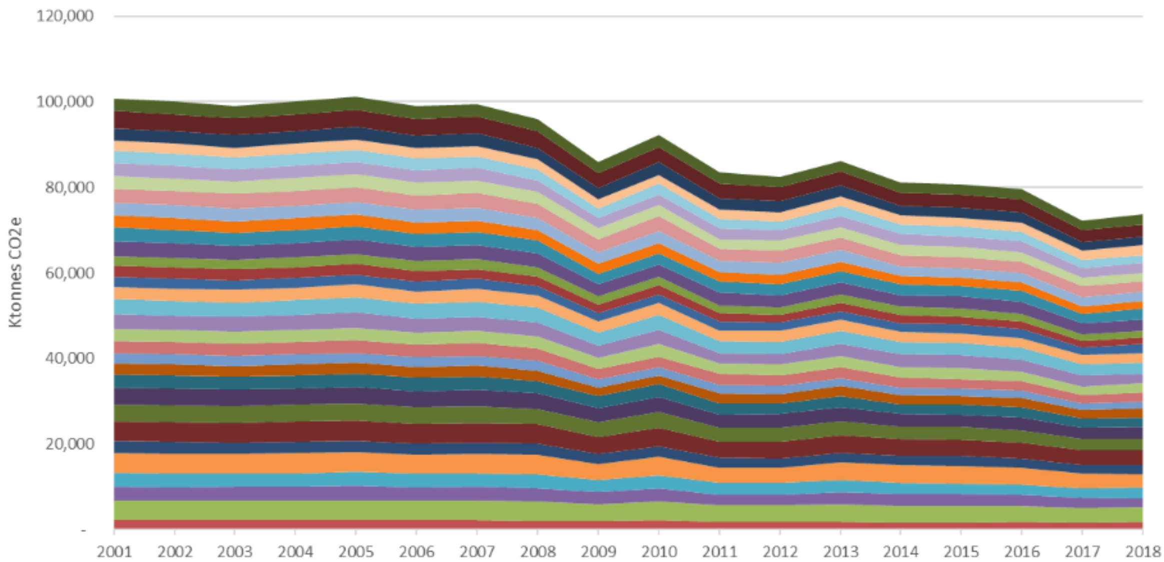
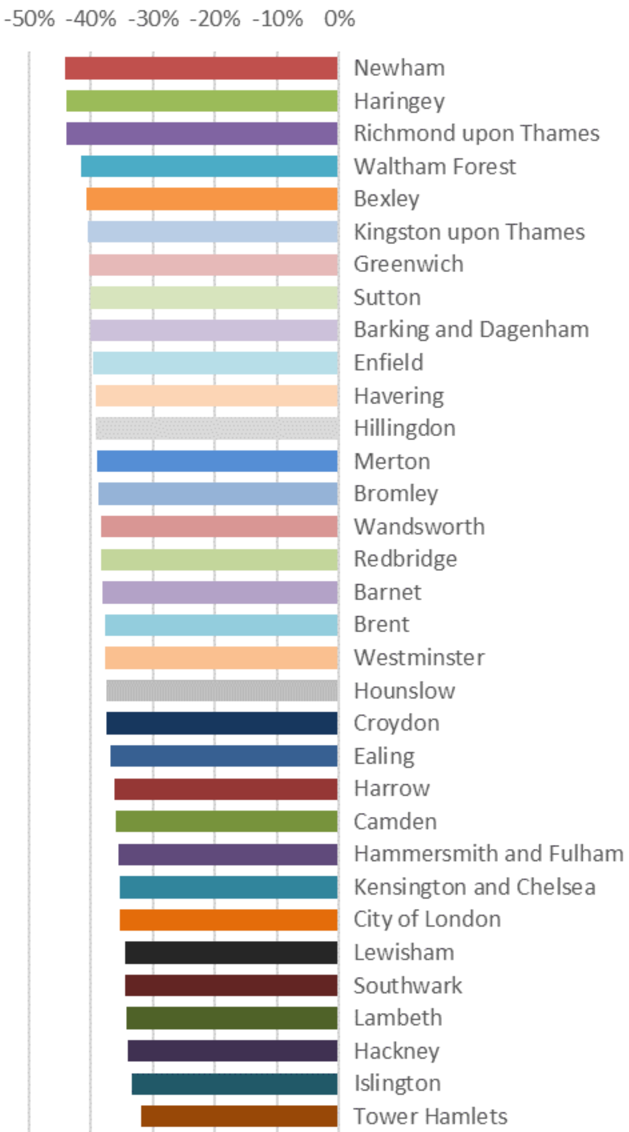


Figure 2: Cumulative HCBA for all London boroughs and the City of London

Every London borough has seen a reduction in their total HCBA with Kensington and Chelsea reducing by the largest proportion (37.2 per cent) and Tower Hamlets reducing by the smallest (7.5 per cent), starting from a relatively high and relatively low base to start with (see Figure 3a).

London has seen population growth in the period 2001-2018. On a per capita basis, which takes account of population changes within London, the reductions are even more significant. Newham has seen the largest reduction (44.0 per cent) and Tower Hamlets the least (31.8 per cent) (see Figure 3b).



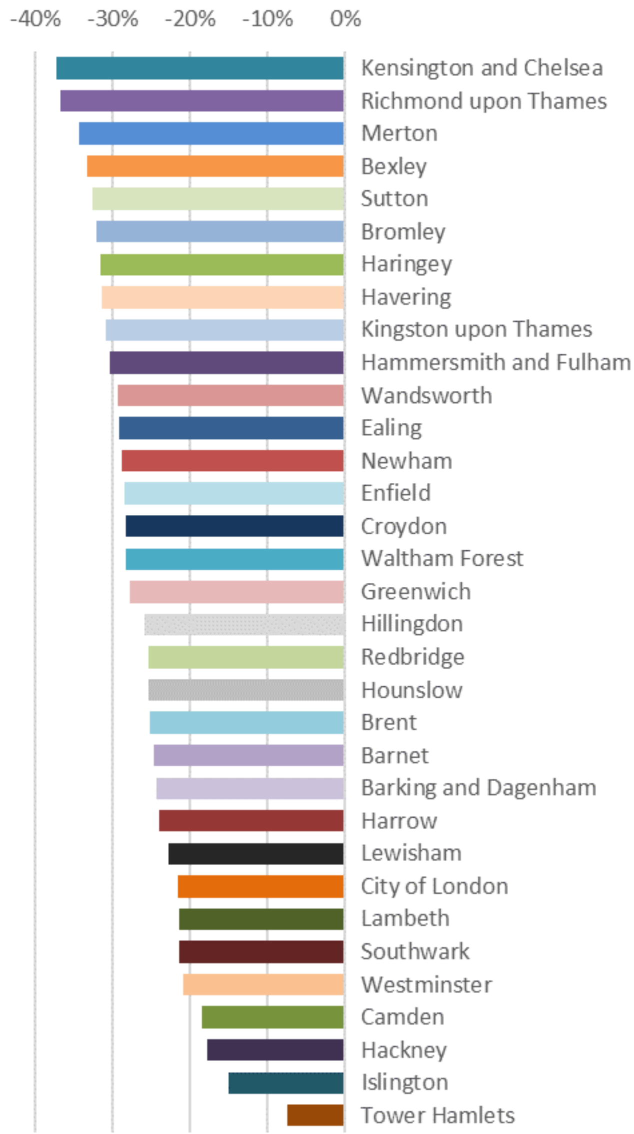


Figure 3a: Percentage change in total HCBA for all London boroughs and the City of London between 2001 and 2018

Figure 4b: Percentage change in per capita HCBA for all London boroughs and the City of London between 2001 and 2018

In addition to seeing overall reductions in HCBA GHG emissions per capita, the variation in impact has reduced over the time-period with a standard deviation of 1.55 tonnes in 2001 and 0.94 tonnes in 2018 (Table 5).

Table 5: Summary statistics for 2001 and 2018

	2001	**2018**
Max (tonnes CO2e per capita)	17.33 (City of London)	11.22 (City of London)
Min	10.27 (Tower Hamlets)	6.03 (Newham)
Standard deviation	1.55	0.94

The breakdown of HCBA by high level product groups is similar for all boroughs in 2018 (Figure). In every borough, the item with the largest impact is transport, followed by housing and power. Transport has the largest range (1.83 tonnes) in per capita HCBA, ranging from 4.15 tonnes in the City of London to 2.32 in Newham. The range (1.63 tonnes) of values for housing and power is between 3.35 tonnes in Kensington and Chelsea and 1.73 tonnes in Newham. Please see the Appendix for information as to what is contain in each product group.

In London, food and drink makes up 10.9 per cent of an average household CBA. In the wealthier areas of the City of London and Kensington and Chelsea this proportion is slightly smaller (9.9 per cent and 9.6 per cent respectively). We see a greater proportion of impact associated with restaurants and hotels in the City of London (8.1per cent) compared to the average (7.0 per cent). In general, the wealthy areas have larger than average impacts, driven by spends on goods such as clothing, air travel, recreation and other services.

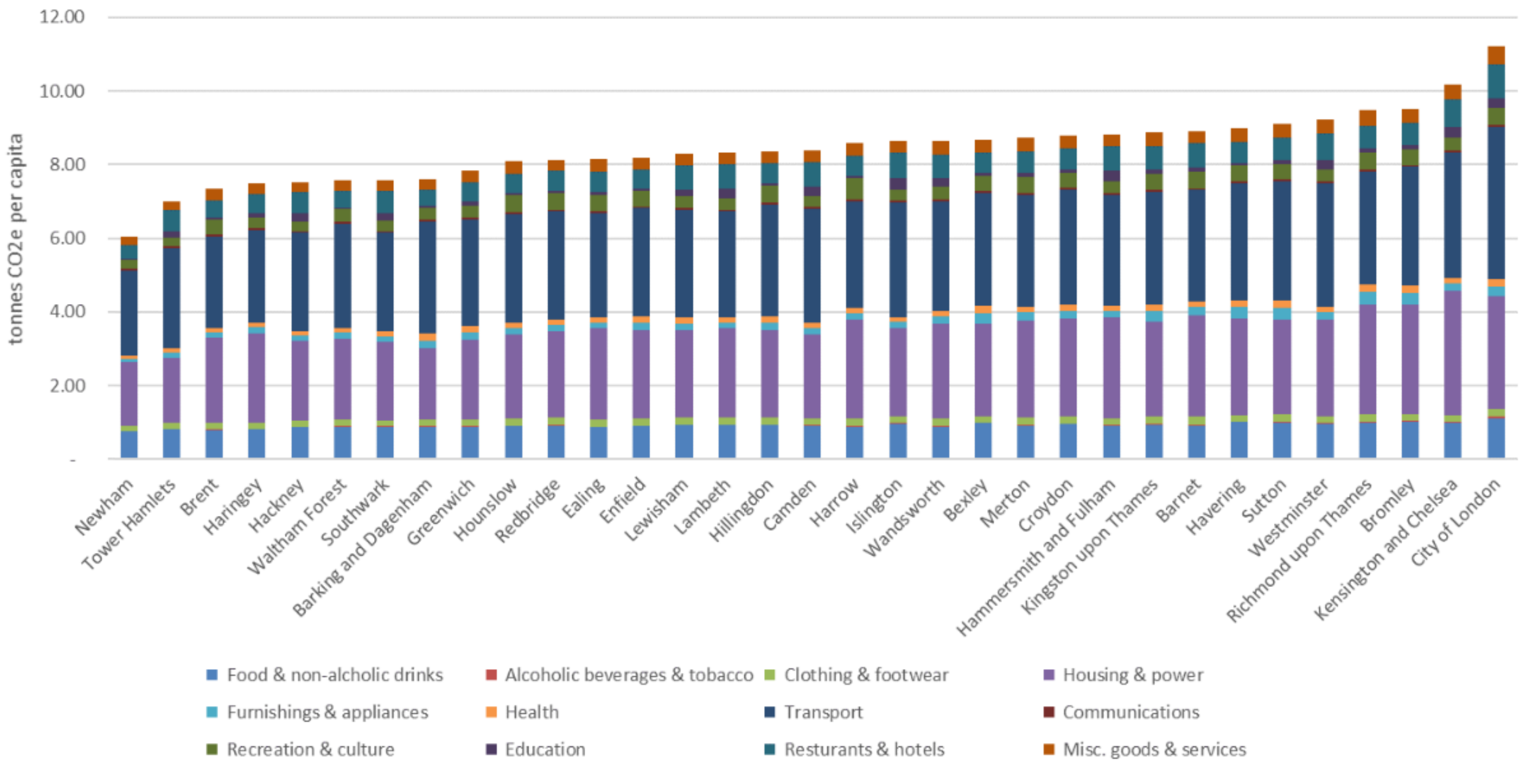


Figure 4: Breakdown of HCBA per capita by high level consumption items for all London Boroughs and the City of London (2018)

4.2 Guide to using the individual borough level datasets

An Excel dataset has been produced for each of the 32 London Boroughs and the City of London. The first sheet (see Figure 5) is a menu of the type of data that can be viewed for the specific local area.

Harrow **Consumption-based household emissions**

Produced by University of Leeds

UNIVERSITY OF LEEDS

Workbook Contains

1 Dashboard
2 Total emissions by source region (2001-2018)
3 Emissions by detailed COICOP classification (2001-2018)
4 Emissions per capita by detailed COICOP classification (2001-2018)
5 Emissions by aggregated product group (2001-2018)
6 Emissions by source industry (2001-2018)
7 Emissions by GHG protocol (2001-2018)
8 Index chart by product group (2001-2018)
9 Comparison with region and UK by product (2001-2018)
10 Start of datasheets

Figure 5: The overview sheet in the borough level dataset

The remainder of the dataset is as follows:

1. Dashboard – this is a summary sheet showing headline results for the borough
2. Total emissions by source region (2001-2018) – this is the total HCBA broken down by the region of origin of the emissions
3. Emissions by detailed COICOP classification (2001-2018) – this shows the total emissions at the most detailed level or 307 different COICOP products
4. Emissions per capita by detailed COICOP classification (2001-2018) – this is the same as (3) but divided by population to show per capita emissions
5. Emissions by aggregated product group (2001-2018) – the emissions by 12 high-level product groups
6. Emissions by source industry (2001-2018) – this is the HCBA broken down by the industry of origin of the emissions
7. Emissions by GHG protocol (2001-2018) – this is the HCBA broken down by scopes 1, 2 and 3
8. Index chart by product group (2001-2018) – chart showing relative change from 2001 of the 12 high-level product groups
9. Comparison with region and UK by product (2001-2018) – sheet showing 12 per capita HCBA charts for each of the high-level product groups, for the borough, GLA and UK
10. Start of the datasheets – the core datasheets that are used to construct the previous 9 sheets start from this point

In the following sections we deep dive into the results of Harrow as an example of how to interpret the data.

4.2.1 Total and per capita emissions time series

The first two charts on the dashboard show the time series of total household consumption-based emissions for Harrow and a comparison of the per capita emissions with London as a whole and the whole of the UK. Comparing the blue line for Harrow on Figure 6 and Figure 7 reveals how population growth effects the emissions estimate and that the per capita reduction is steeper. Harrow has a larger than average HCBA compared to London as a whole and the UK. Most of the reduction in emissions occurred between 2008 and 2011 and 2015 and 2016. Country-wide, we see large reductions in emissions during the 2007-2009 recession and more recently due to decarbonisation of the electricity sector.

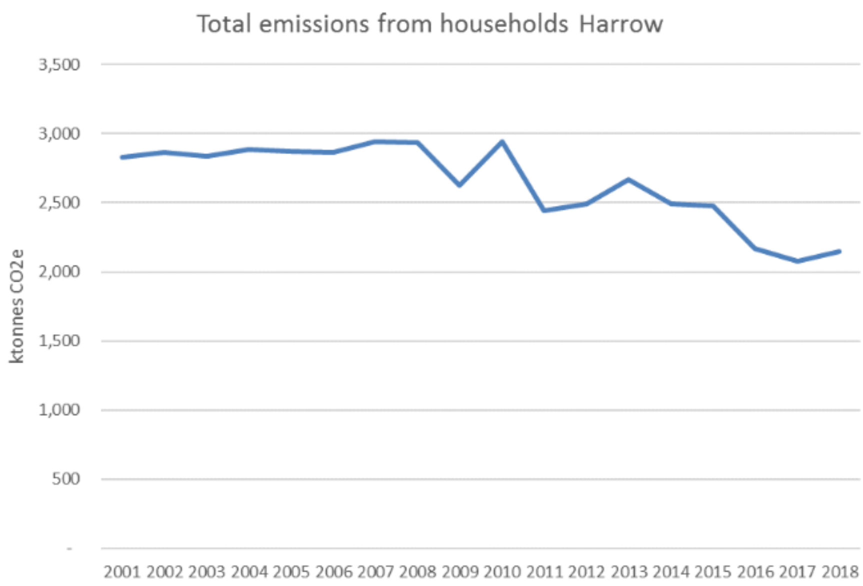


Figure 6: Total emissions from households for Harrow 2001-2018

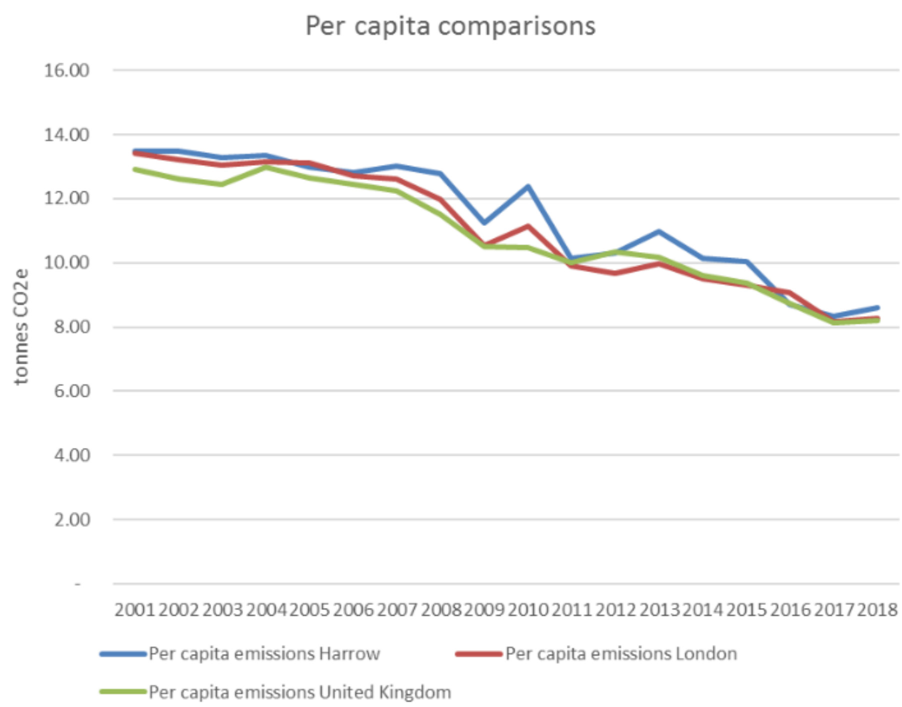


Figure 7: Per capita household emission for Harrow, London and the UK 2001-2018

4.2.2 Emissions breakdown by source and final product

The third chart (Figure 8) on the dashboard shows the total household CBA for Harrow broken down in three different ways:

- Where in the world the emissions were released to meet consumption by Harrow residents?
- Which industries were responsible for these emissions?
- Which final products are the emissions embodied in?

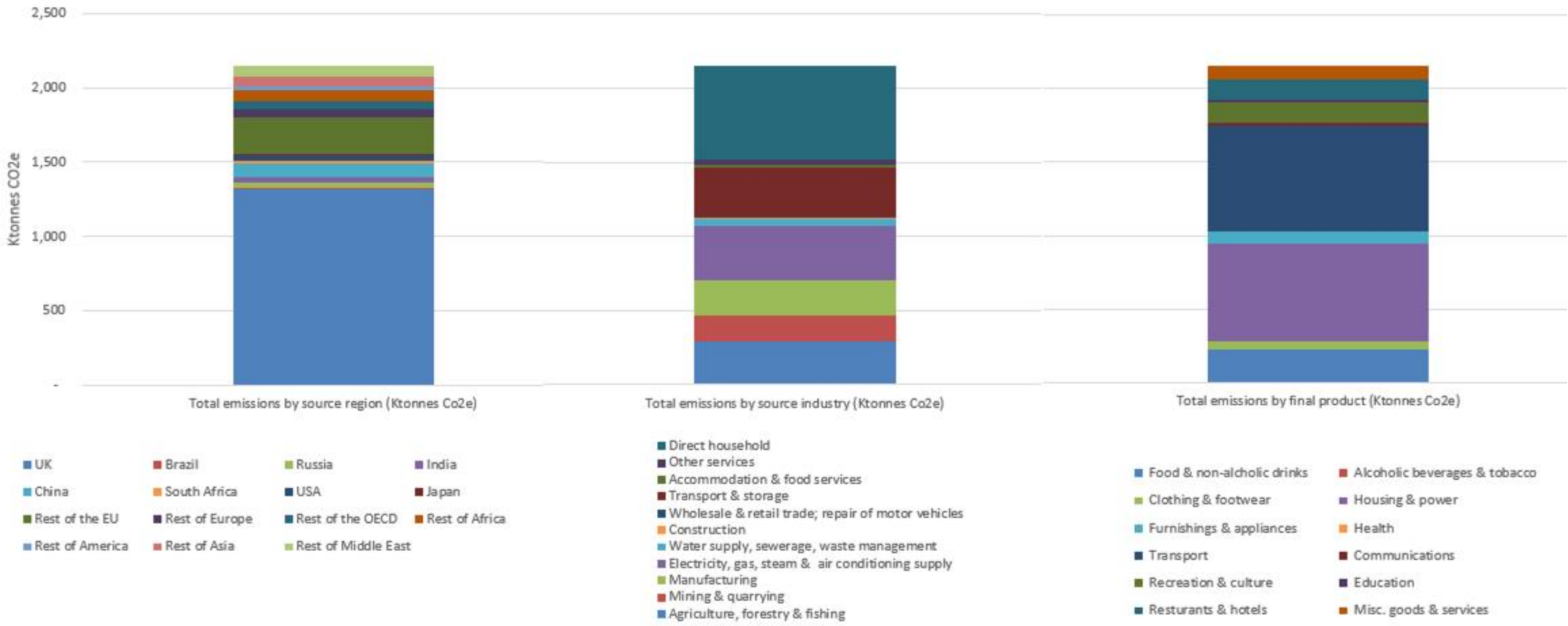


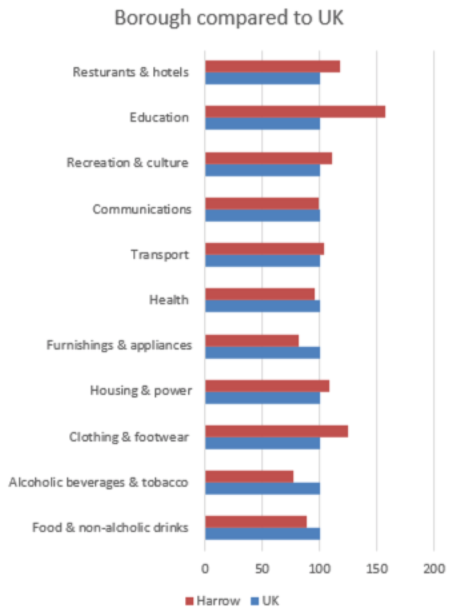
Figure 8: Breakdown of total Harrow HCBA by source and final product (2018)

The greatest proportion (61.1per cent) of emissions associated with Harrow household's consumption are released in the UK. This is due to the large proportion of consumption associated with home heating and personal transport. A further 11.6 per cent are emissions from the EU. The UK imports many products from the continent, particularly agriculture. 29.2 per cent of Harrow's household consumption emissions are direct household emissions from burning fuel in the home and personal transport. A further 17.1 per cent can be traced back to the production of electricity used both in the home and in the supply chain of other goods. The final stacked bar in Figure 8 is the same breakdown shown in Figure 4. These type of breakdown charts can be useful in order to understand where emissions reduction policy should focus.

For example, in Harrow, policy makers may consider targeting emissions from the three largest consumption areas: transport, housing & power and food & non-alcoholic drinks. The breakdown shows that targeting emissions associated with household spend on education will not be associated with large reduction

4.2.3 Product based comparisons with the UK and London

Figure 9 allows the user to compare the average levels of consumption in the borough with averages for the whole of the UK and the whole of London. The chart is a propensity chart with the UK and London set at 100 and the borough level is compared to this index level. For example, Harrow has a level of 82 for furnishing and appliances meaning that the average household in Harrow spends 82 per cent of the UK average for this product type and consequently has a lower-than-average impact for this category of spend. For recreation and culture, Harrow has a level of 153 compared to London, meaning that residents of Harrow spend and have an impact 53 per cent higher than the average London resident for this category of spend.



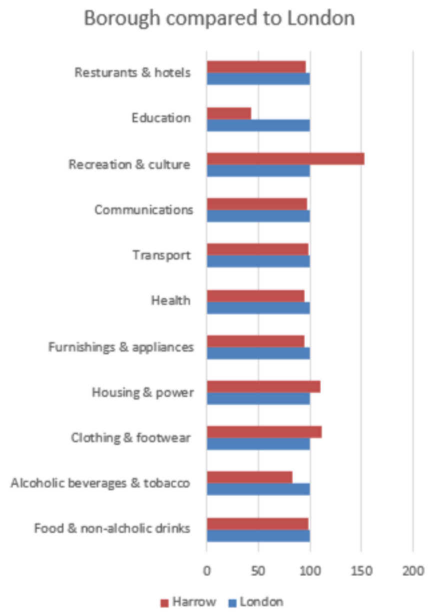


Figure 9: Product based comparisons for Harrow with the UK and London (2018)

This type of data can be useful in understanding why a borough has a lower or higher than average impact compared to London or the UK. Harrow has a higher-than-average impact for housing and power. The policy maker may want to investigate if this could be due to a less-than-average efficiency of housing stock.

4.2.4 Ranked comparisons with the rest of London

The next few charts in the dashboard compare total and per capita results for Harrow with the other London boroughs and the City of London. The borough of Harrow is highlighted in red.

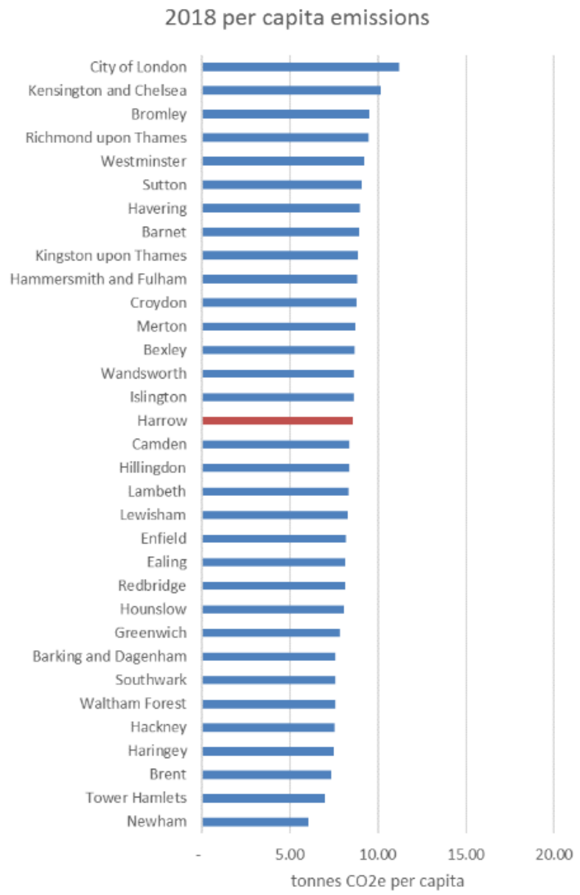


Figure 10: Per capita results comparing the borough of Harrow with the other London boroughs and the City of London (2018)

Ranked charts can be useful when comparing two boroughs with similar characteristics but different household emissions profiles. Are there two boroughs with similar levels of wealth but very different housing and power impacts? Comparing the borough rankings over time might reveal information about how some areas have changed and some have not.

4.2.5 Breakdown of OAC subgroups

The final chart on the dashboard shows the make-up of OAC subgroups in the borough. In 2018, there are an estimated 105,599 residents living in output areas classified as type 4c2 Multicultural new arrivals. This is the largest group (42.2per cent), followed by 4c1, achieving minorities and 4c3, inner city ethnic mix.

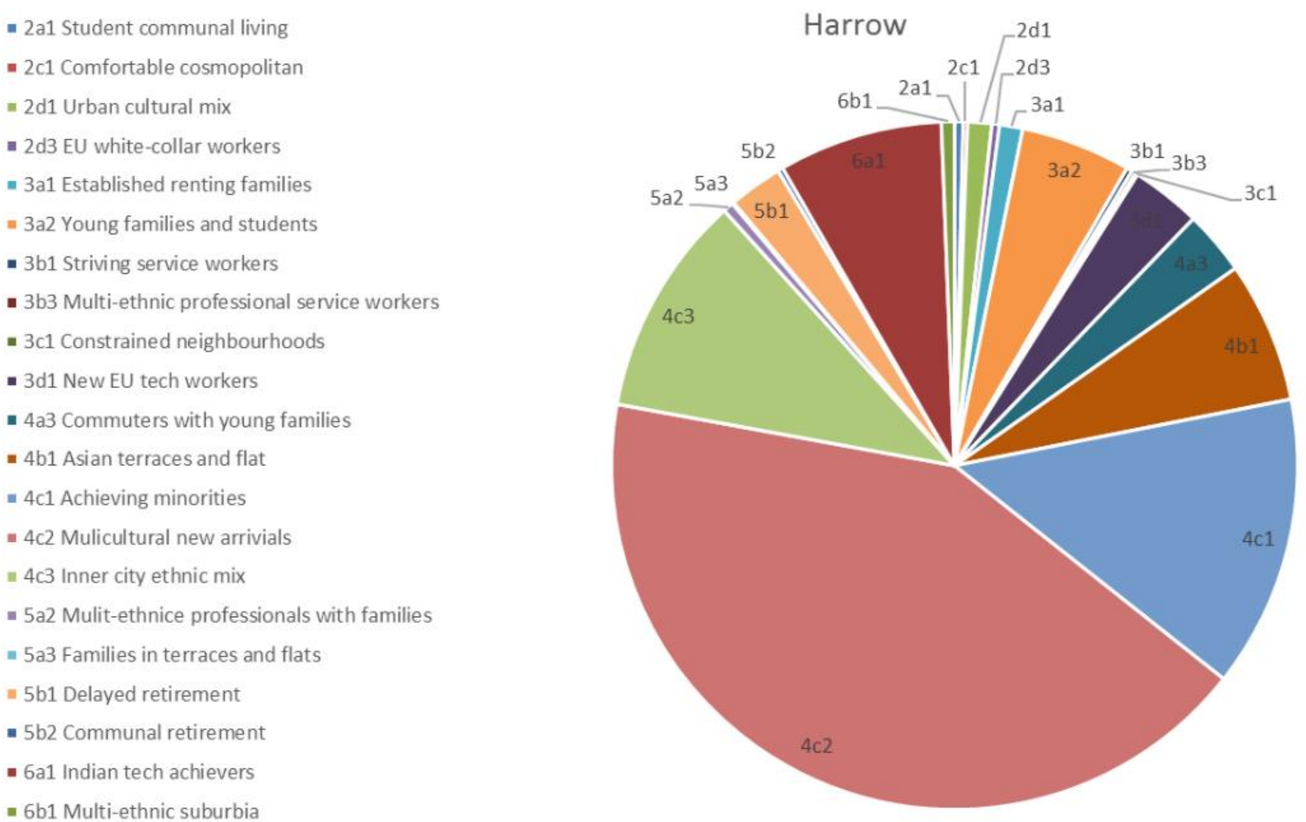


Figure 11: OAC subgroups in Harrow by population (2018)

In the 'backend' of the spreadsheet you can find further information about the OAC for earlier years. Sheets in the format 'ghg_year_oac' show the population by OAC type and the higher level OAC substitutions made where this was necessary.

4.2.6 Source region time series

The next sheet in the dataset, shows the breakdown by source region for the entire timeseries.

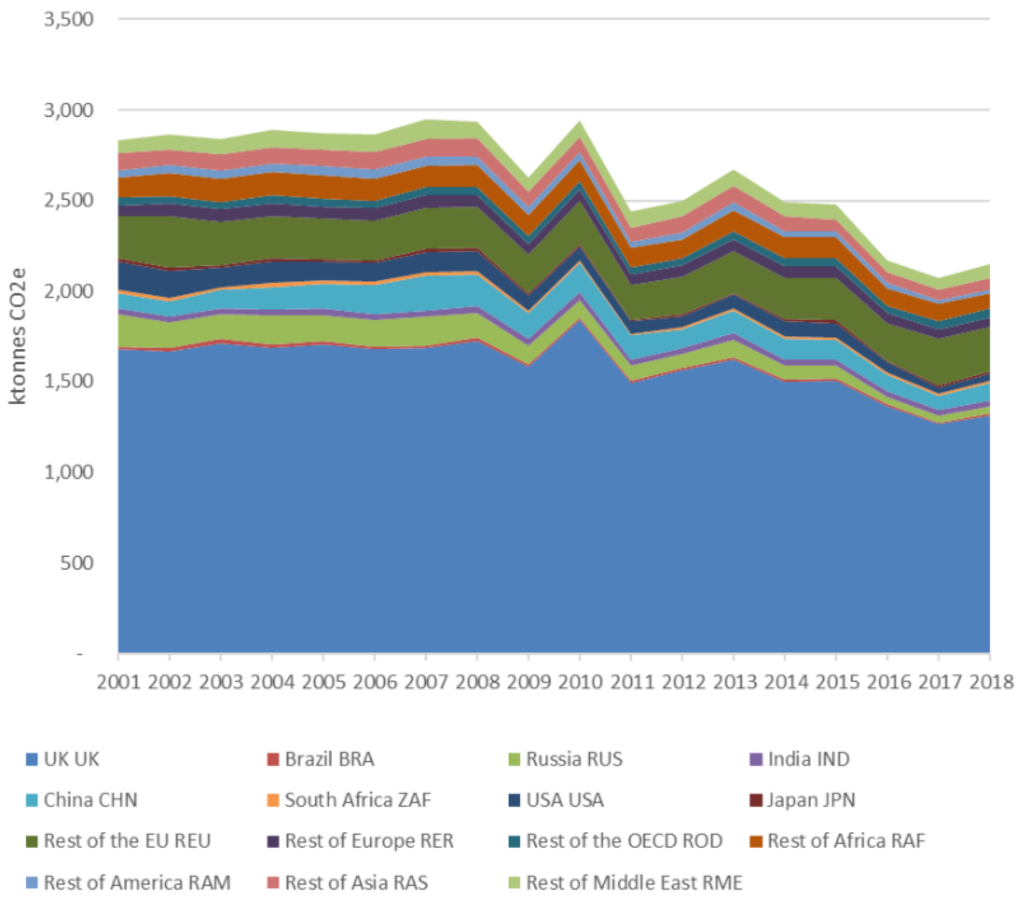


Figure 12: Breakdown of total HCBA for Harrow by source region (2001-2018)

In 2001, imported emissions contributed 40.8 per cent of the total HCBA, compared to 38.9 per cent in 2018. Post-recession, imported emissions reduced by a greater proportion than domestic emissions because households reduced expenditure on consumables by a greater amount than spend on heating, power and local transportation where emissions are predominantly domestic.

4.2.7 Further detailed breakdowns by year, product, industry and scope

Sheets 3 and 4 show the most detailed breakdown of the results by total and by per capita. At the most detailed level, borough results can be viewed by 307 product types. However, it is not recommended that results are used at this level. As a general rule, the more granular the results, the less accurate the numbers are. Due to the way the UKMRIO database is constructed, although there is information about the spend levels by 307 product groups, by the different OAC types, the CO2e conversion factors operate best at a more aggregated level. Many of the product types have the same conversion factor because the model can only determine a conversion factor for clothing, for example not at the level of 'womens' under garments'. It is recommended that the 12 product types shown in previous figures are adopted for reporting purposes. However, if the user wants to understand the portion of the transport impact that is passenger travel by air, for example, sheets 3 and 4 can help disaggregate the results for this type of analysis.

Sheet 6 breaks down the emissions by year and 114 source industries and sheet 7 reclassifies the emissions to fit the Scope 1, 2 and 3 categories used in the GHG protocol.

4.2.8 Product-based time-series comparisons and a note on noise in the data

Sheet 9 reveals how the per capita impact for the borough has changed over time for each of the 12 high-level product groups. A comparison with the London and UK averages is also shown. Figure 13 shows that Harrow's food and drink impact per capita is lower than the UK average and similar to that of London.

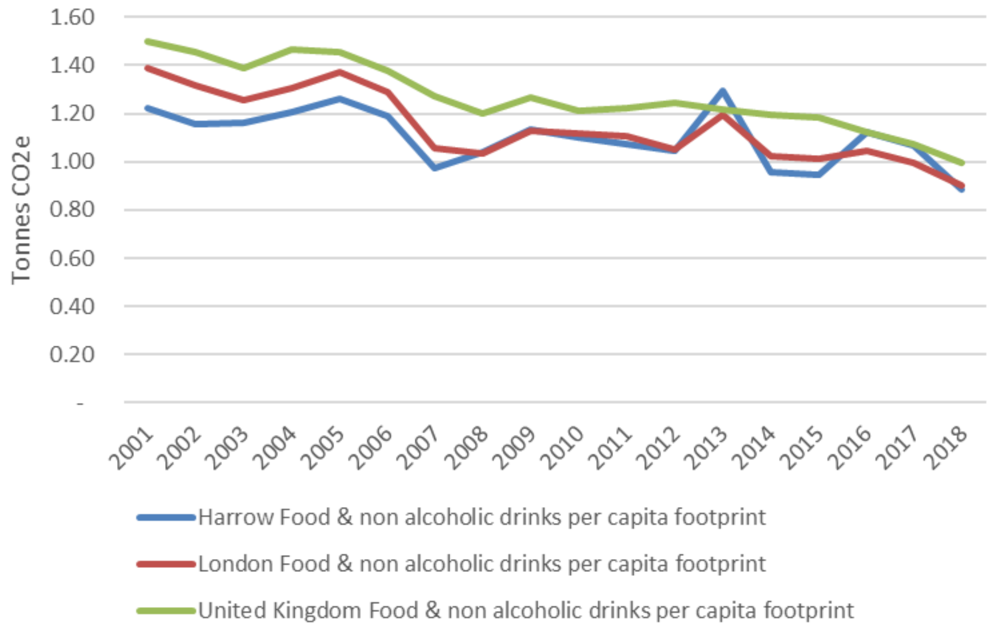


Figure 13: Per capita food and non-alcoholic drinks HCBA for Harrow, London and UK (2001-2018)

Note that the UK data is a relatively smooth line, whereas London, then the borough get progressively more jagged. A more extreme example of this can be seen in Figure 14, the health impact chart, where there is a significant spike in 2007.

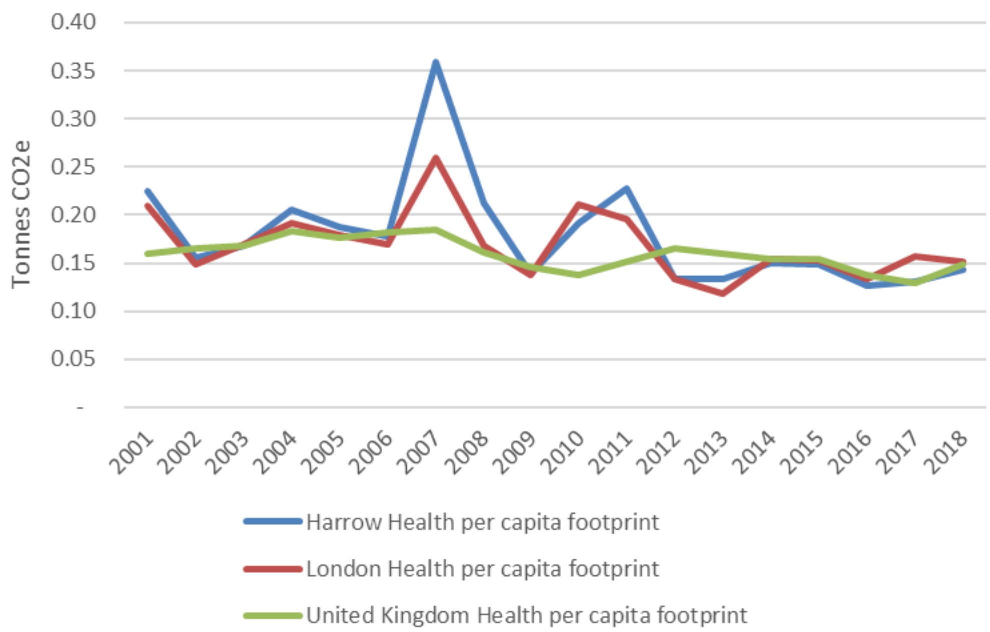


Figure 14: Per capita health HCBA for Harrow, London and UK (2001-2018)

This irregularity or noise further demonstrates how the aggregated data is more accurate than the disaggregated values. The UK trend for health is smooth and it gets more erratic, the smaller the geography. The reason for this is that health expenditure in the LCFS is a sporadic spend – not something that every household spends money on every week. In 2007, London households were disproportionately captured as spending a larger than average share of the total UK spend on private health services and those OAC type that spent on this category were concentrated in Harrow, meaning the spike appears even larger. With this type of sporadic spend item, we recommend considering a 'line of best fit' approach to the footprint, viewing the overall trend (slight reduction) rather than giving too much importance to individual years' values.

Fortunately, the consumption items that are most important in a household account are items that are bought frequently (food, fuel, transportation) and do not suffer from noise in the data due to sporadic spend. The expenditure categories where the consumption impact is erratic have a very low overall impact.

4.2.9 Advanced level analysis

Further sheets in the back end of the spreadsheet allow for further breakdown of the results. For example, sheet 'ghg_2001_reg' shows the source emission region by product type in the year 2001. Here you can determine that three quarters of the emissions associated with household appliances are imported, for example. Or sheet 'ghg_2018_ind' can be used to show the source industries associated with each product. Here you can predict how each product may reduce its impact if the emissions associated with 'electric power generation' were zero.

5 Conclusions, recommendations and next steps

5.1 Overall findings

The University of Leeds has successfully developed a robust and replicable methodology to calculate the household consumption-based GHG account of all 32 London Boroughs and the City of London. The results show that household consumption emissions have reduced significantly across all boroughs in the period 2001-2018. However further action is needed to reach targets at the borough, region and national level. We find that major areas of consumption are broadly consistent across boroughs – emissions from transport, housing & power and food represent the majority of a HCBA. There is some variation across the boroughs with the richest boroughs having the highest impact for non-essential consumption items like hotels and restaurant spend. We have recommended caution in using results at the more granular levels where there is potential for noise in the data but we are confident that the overall trends accurately indicate the direction of travel in emissions.

The results presented provide an important borough level picture for how boroughs and the region can focus efforts to reduce emissions in line with adopted targets.

5.2 Comment on methodology, data sources and update potential

The methodology used ensures that the sum of the London boroughs plus the City of London equals the reported HCBA for the GLA. The data used to disaggregate the GLA's HCBA to the individual borough level is free, open source and annually updated. Now that the methodology has been established, updating the dataset for 2019 should be a relatively straight forward process. The UKMRIO database will be updated in early 2022 and will be capable of reporting the UK CBA for 1990-2019. This data will be published in Spring 2022 alongside the GLA CBA for 2001-2019. Once this data is published, the 2019 borough and City of London results could be processed.

2021 is a census year, which means there will be a new 2021 Output Area Classification and any changes to an area's character can be reflected. It takes a number of years for the census to be processed and for a new OAC to be finalised. It is unlikely that we will see a 2021 OAC reflected in the LCFS until 2024. In addition, the UKMRIO database is always 3 years out of date due to the time it takes to update the National Accounts. This means that we will not see the effects of a new OAC until publication of 2024 in 2027.

It is important to note that the underlying model, the UKMRIO database, is completely updated each year and the entire time series is re-estimated to reflect any updates to data sources and methodological improvements. This means that results for 2001-2018 may be re-estimated in 2022 and change slightly. This will affect the London borough HCBA and it is recommended that the entire time series is re-estimated each year, rather than simply reporting the next additional year.

5.3 Recommendation for wider coverage

This project has demonstrated that it is possible to disaggregate HCBA for the UK regions down to the local authority level. The data used for the London boroughs is available for all the other regions in England and for the devolved nation of Wales. This means it would be simple to produce results datasheets for all local authorities in England and Wales. Scottish census data is recorded slightly differently but we are confident that this methodology could also be applied to the Scottish Local Authorities. The OAC is not recorded for Northern Irish households in the LCFS so an alternate approach would need to be developed to disaggregate HCBA in Northern Ireland.

London Councils has led the way in commissioning data on consumption-based emissions accounts for the boroughs and the City of London. As accounting for emissions from consumption continues to move up the political agenda, and the UK starts to consider how to develop targets for consumption emissions reductions, it is likely that more and more local councils will request consumption-based emissions estimates. These results will only be meaningful if developed in a manner consistent with the national level results. We strongly recommend that this London case study becomes the blueprint for the rest of the country.

6 References

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7 Appendix

7.1 Input-output analysis

The Leontief Input-Output model is constructed from observed economic data and shows the interrelationships between industries that both produce goods (outputs) and consume goods (inputs) from other industries in the process of making their own product (Miller & Blair, 2009).

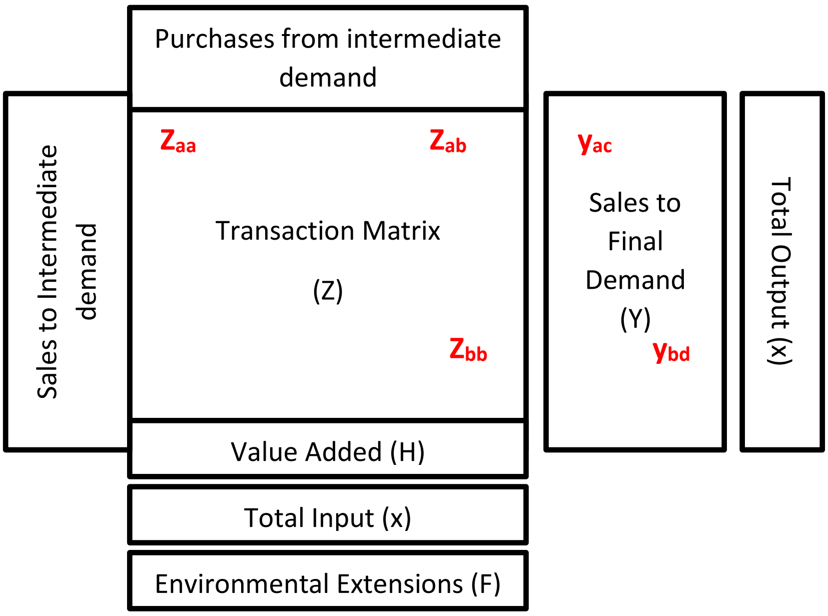

Figure 15: Basic structure of a Leontief Input-Output Model

Consider the transaction matrix $\mathbf{Z}$; reading across a row reveals which industries a single industry sells to and reading down a column reveals who a single industry buys from. A single element, $\mathbf{z}_{ij}$, within $\mathbf{Z}$, represents the contributions from the ith sector to the jth industry or sector in an economy. For example, $\mathbf{z}_{aa}$ represents the ferrous metal contribution in making ferrous metal products, $\mathbf{z}_{ab}$, the ferrous metal contribution to car products and $\mathbf{z}_{bb}$ the car production used in making cars. Final demand is the spend on finished goods. For example, $\mathbf{y}_{ac}$ is the spend on ferrous metal products by households as final consumers whereas $\mathbf{y}_{bd}$ is the spend on car products by government as final consumers.

The total output ($\mathbf{x}_i$) of a particular sector can be expressed as:

$$\mathbf{x}_{i=}\mathbf{z}_{i1} + \mathbf{z}_{i2} + \cdots + \mathbf{z}_{ij} + \mathbf{y}_i \qquad (1)$$

where $\mathbf{y}_i$ is the final demand for that product produced by the particular sector. If each element, $\mathbf{z}_{ij}$, along row i is divided by the output $\mathbf{x}_i$, associated with the corresponding column j it is found in, then each element in $\mathbf{Z}$ can be replaced with:

$$\mathbf{a}_{ij} = \frac{\mathbf{z}_{ij}}{\mathbf{x}_j} \qquad (2)$$

to form a new matrix $\mathbf{A}$.

Substituting for (2) in equation (1) forms:

$$\mathbf{x}_{i=}\mathbf{a}_{i1}\mathbf{x}_1 + \mathbf{a}_{i2}\mathbf{x}_2 + \cdots + \mathbf{a}_{ij}\mathbf{x}_i + \mathbf{y}_i \qquad (3)$$

Which, if written in matrix notation is $= \mathbf{Ax} + \mathbf{y}$ *.* Solving for $\mathbf{y}$ gives:

$$\mathbf{x} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} \qquad (4)$$

where $\mathbf{x}$ and $\mathbf{y}$ are vectors of total output and final demand, respectively, $\mathbf{I}$ is the identity matrix, and $\mathbf{A}$ is the technical coefficient matrix, which shows the inter-industry requirements. $(\mathbf{I} - \mathbf{A})^{-1}$ is known as the Leontief inverse (further identified as $\mathbf{L}$). It indicates the inter-industry requirements of the i^{th} sector to deliver a unit of output to final demand. Since the 1960s, the IO framework has been extended to account for increases in the pollution associated with industrial production due to a change in final demand (Kitzes, 2013).

Consider, a row vector $\mathbf{f}$ of annual GHG emissions generated by each industrial sector

$$\mathbf{e} = \mathbf{f}\hat{\mathbf{x}}^{-1} \qquad (5)$$

is the coefficient vector representing emissions per unit of output[4]. Multiplying both sides of (4) by $\mathbf{e}'$ gives

$$\mathbf{e}'\mathbf{x} = \mathbf{e}'\mathbf{L}\mathbf{y} \qquad (6)$$

and simplifies to

$$\mathbf{F} = \mathbf{e}'\mathbf{L}\mathbf{y} \qquad (7)$$

where $\mathbf{F}$ is the GHG emissions in matrix form allowing consumption-based emissions to be determined. $\mathbf{F}$ is calculated by pre-multiplying $\mathbf{L}$ by emissions per unit of output and post-multiplying by final demand. This system can be expanded to the global scale by considering trade flows between every industrial sector in the world rather than within a single country. This type of system requires a multi-regional input –output (MRIO) table (Peters et al., 2011).

To calculate the emissions associated with a subset of the total region, the final demand vector $\mathbf{y}$ is replaced with the final demand corresponding to the area of focus. For example, if the final demand vector $\mathbf{y\_harrow}$ is used which shows final demand by product for households in Harrow, the calculation $\mathbf{F} = \mathbf{e}'\mathbf{Ly\_harrow}$ will give the consumption-based account for Harrow's households

7.2 Output area classifications for 2001 and 2011

Table 6: 2001 OAC Supergroups

	Supergroup name
1	Blue Collar Communities
2	City Living
3	Countryside
4	Prospering Suburbs
5	Constrained by Circumstances
6	Typical Traits
7	Multicultural

Table 7: 2001 OAC Groups

	Group name
1a	Terraced Blue Collar
1b	Younger Blue Collar

[4] $\hat{}$ denotes matrix diagonalisation and $'$ denotes matrix transposition

1c	Older Blue Collar
2a	Transient Communities
2b	Settled in the City
3a	Village Life
3b	Agricultural
3c	Accessible Countryside
4a	Prospering Younger Families
4b	Prospering Older Families
4c	Prospering Semis
4d	Thriving Suburbs
5a	Senior Communities
5b	Older Workers
5c	Public Housing
6a	Settled Households
6b	Least Divergent
6c	Young Families in Terraced Homes
6d	Aspiring Households
7a	Asian Communities
7b	Afro-Caribbean Communities

Table 8L 2001 OAC Subgroups

	Subgroup name
1a1	Terraced Blue Collar 1
1a2	Terraced Blue Collar 2
1a3	Terraced Blue Collar 3
1b1	Younger Blue Collar 1
1b2	Younger Blue Collar 2
1c1	Older Blue Collar 1
1c2	Older Blue Collar 2
1c3	Older Blue Collar 3
2a1	Transient Communities 1
2a2	Transient Communities 2
2b1	Settled in the City 1
2b2	Settled in the City 2
3a1	Village Life 1
3a2	Village Life 2
3b1	Agricultural 1
3b2	Agricultural 2
3c1	Accessible Countryside 1
3c2	Accessible Countryside 2
4a1	Prospering Younger Families 1
4a2	Prospering Younger Families 2
4b1	Prospering Older Families 1
4b2	Prospering Older Families 2
4b3	Prospering Older Families 3
4b4	Prospering Older Families 4
4c1	Prospering Semis 1
4c2	Prospering Semis 2

4c3	Prospering Semis 3
4d1	Thriving Suburbs 1
4d2	Thriving Suburbs 2
5a1	Senior Communities 1
5a2	Senior Communities 2
5b1	Older Workers 1
5b2	Older Workers 2
5b3	Older Workers 3
5b4	Older Workers 4
5c1	Public Housing 1
5c2	Public Housing 2
5c3	Public Housing 3
6a1	Settled Households 1
6a2	Settled Households 2
6b1	Least Divergent 1
6b2	Least Divergent 2
6b3	Least Divergent 3
6c1	Young Families in Terraced Homes 1
6c2	Young Families in Terraced Homes 2
6d1	Aspiring Households 1
6d2	Aspiring Households 2
7a1	Asian Communities 1
7a2	Asian Communities 2
7a3	Asian Communities 3
7b1	Afro-Caribbean Communities 1
7b2	Afro-Caribbean Communities 2

Table 9: 2011 OAC Supergroups

	Supergroup name
1	Rural residents
2	Cosmopolitans
3	Ethnicity central
4	Multicultural metropolitans
5	Urbanites
6	Suburbanites
7	Constrained city dwellers
8	Hard-pressed living

Table 10: 2011 OAC Groups

	Group name
1a	Farming communities
1b	Rural tenants
1c	Aging rural dwellers
2a	Students around campus
2b	Inner city students
2c	Comfortable cosmopolitan
2d	Aspiring and affluent

3a	Ethnic family life
3b	Endeavouring Ethnic Mix
3c	Ethnic dynamics
3d	Aspirational techies
4a	Rented family living
4b	Challenged Asian terraces
4c	Asian traits
5a	Urban professionals and families
5b	Ageing urban living
6a	Suburban achievers
6b	Semi-detached suburbia
7a	Challenged diversity
7b	Constrained flat dwellers
7c	White communities
7d	Ageing city dwellers
8a	Industrious communities
8b	Challenged terraced workers
8c	Hard pressed ageing workers
8d	Migration and churn

Table 11L 2011 OAC Subgroups

	Subgroup name
1a1	Rural workers and families
1a2	Established farming communities
1a3	Agricultural communities
1a4	Older farming communities
1b1	Rural life
1b2	Rural white-collar workers
1b3	Aging rural flat tenants
1c1	Rural employment and retirees
1c2	Renting rural retirement
1c3	Detached rural retirement
2a1	Student communal living
2a2	Student digs
2a3	Students and professionals
2b1	Students and commuters
2b2	Multicultural student neighbourhoods
2c1	Comfortable cosmopolitan
2c2	Migrant commuters
2c3	Professional service cosmopolitans
2d1	Urban cultural mix
2d2	Highly-qualified quaternary workers
2d3	EU white-collar workers
3a1	Established renting families
3a2	Young families and students
3b1	Striving service workers
3b2	Bangladeshi mixed employment
3b3	Multi-ethnic professional service workers

3c1	Constrained neighbourhoods
3c2	Constrained commuters
3d1	New EU tech workers
3d2	Established tech workers
3d3	Old EU tech workers
4a1	Social renting young families
4a2	Private renting new arrivals
4a3	Commuters with young families
4b1	Asian terraces and flat
4b2	Pakistani communities
4c1	Achieving minorities
4c2	Multicultural new arrivals
4c3	Inner city ethnic mix
5a1	White professionals
5a2	Multi-ethnic professionals with families
5a3	Families in terraces and flats
5b1	Delayed retirement
5b2	Communal retirement
5b3	Self-sufficient retirement
6a1	Indian tech achievers
6a2	Comfortable suburbia
6a3	Detached retirement living
6a4	Ageing in suburbia
6b1	Multi-ethnic suburbia
6b2	White suburban communities
6b3	Semi-detached ageing
6b4	Older workers and retirement
7a1	Transitional Eastern European neighbourhoods
7a2	Hampered aspiration
7a3	Multi-ethnic hardship
7b1	Eastern European communities
7b2	Deprived neighbourhoods
7b3	Endeavouring flat dwellers
7c1	Challenged transitionaries
7c2	Constrained young families
7c3	Outer city hardship
7d1	Ageing communities and families
7d2	Retired independent city dwellers
7d3	Retired communal city dwellers
7d4	Retired city hardship
8a1	Industrious transitions
8a2	Industrious hardship
8b1	Deprived blue-collar terraces
8b2	Hard pressed rented terraces
8c1	Ageing industrious workers
8c2	Ageing rural industry workers
8c3	Renting hard-pressed workers
8d1	Young hard-pressed families
8d2	Hard-pressed ethnic mix
8d3	Hard-pressed European Settlers

7.3 COICOP breakdown of high-level product groups

1. Food and Non-Alcoholic Drinks
1.1.1.1 Rice
1.1.1.2 Bread
1.1.1.3 Other breads and cereals
1.1.2 Pasta products
1.1.3.1 Buns, crispbread and biscuits
1.1.3.2 Cakes and puddings
1.1.4 Pastry (savoury)
1.1.5 Beef (fresh, chilled or frozen)
1.1.6 Pork (fresh, chilled or frozen)
1.1.7 Lamb (fresh, chilled or frozen)
1.1.8 Poultry (fresh, chilled or frozen)
1.1.9 Bacon and ham
1.1.10.1 Sausages
1.1.10.2 Offal, pate etc
1.1.10.3 Other preserved or processed meat and meat preparations
1.1.10.4 Other fresh, chilled or frozen edible meat
1.1.11.1 Fish (fresh, chilled or frozen)
1.1.11.2 Seafood, dried, smoked or salted fish
1.1.11.3 Other preserved or processed fish and seafood
1.1.12.1 Whole milk
1.1.12.2 Low fat milk
1.1.12.3 Preserved milk
1.1.13 Cheese and curd
1.1.14 Eggs
1.1.15.1 Other milk products
1.1.15.2 Yoghurt
1.1.16 Butter
1.1.17 Margarine and other vegetable fats and peanut butter
1.1.18.1 Olive oil
1.1.18.2 Edible oils and other animal fats
1.1.19.1 Citrus fruits
1.1.19.2 Bananas
1.1.19.3 Apples
1.1.19.4 Pears
1.1.19.5 Stone fruits
1.1.19.6 Berries
1.1.20 Other fresh, chilled or frozen fruits
1.1.21 Dried fruit and nuts
1.1.22 Preserved fruit and fruit-based products
1.1.23.1 Leaf and stem vegetables
1.1.23.2 Cabbages
1.1.23.3 Vegetables grown for their fruit
1.1.23.4 Root crops, non-starchy bulbs and mushrooms
1.1.24 Dried vegetables
1.1.25 Other prepared or processed vegetables
1.1.26 Potatoes
1.1.27 Other tubers and products of tuber vegetables

1.1.28.1 Sugar
1.1.28.2 Other sugar products
1.1.29 Jams and marmalades
1.1.30 Chocolate
1.1.31 Confectionery products
1.1.32 Edible ices and ice cream
1.1.33.1 Sauces, condiments
1.1.33.2 Baker’s yeast, dessert preparations, soups
1.1.33.3 Salt, spices, herbs and other food products
1.2.1 Coffee
1.2.2 Tea
1.2.3 Cocoa and powdered chocolate
1.2.4 Fruit and vegetable juices
1.2.5 Mineral or spring waters
1.2.6 Soft drinks

2. Alcoholic Drinks and Tobacco
2.1.1 Spirits and liqueurs
2.1.2.1 Wine from grape or other fruit
2.1.2.2 Fortified wine
2.1.2.3 Champagne and sparkling wines
2.1.3.1 Beer and lager
2.1.3.2 Ciders and Perry
2.1.4 Alcopops
2.2.1 Cigarettes
2.2.2.1 Cigars
2.2.2.2 Other tobacco

3. Clothing and Footwear
3.1.1 Men’s outer garments
3.1.2 Men’s under garments
3.1.3 Women’s outer garments
3.1.4 Women’s under garments
3.1.5 Boys outer garments
3.1.6 Girls outer garments
3.1.7 Infants outer garments
3.1.8 Children’s under garments
3.1.9.1 Men’s accessories
3.1.9.2 Women’s accessories
3.1.9.3 Children’s accessories
3.1.9.4 Protective head gear
3.1.10 Haberdashery, clothing materials and clothing hire
3.1.11.1 Dry cleaners and dyeing
3.1.11.2 Laundry, laundrettes
3.2.1 Footwear for men
3.2.2 Footwear for women
3.2.3 Footwear for children and infants
3.2.4 Repair and hire of footwear

4. Housing and Power
4.1.1 Actual rentals
4.1.2 Imputed rent
4.2.1 Central heating repairs
4.2.2 House maintenance
4.2.3 Paint, wallpaper, timber
4.2.4 Equipment hire, small materials
4.3.1 Water charges
4.3.2 Other regular housing payments incl service charge for rent
4.3.3 Refuse collection including skip hire
4.4.1 Electricity
4.4.2 Gas
4.4.3.1 Coal and coke
4.4.3.2 Oil for central heating
4.4.3.3 Paraffin, weed, peat, hot water etc

5. Furnishings and Appliances
5.1.1.1 Furniture
5.1.1.2 Fancy/decorative goods
5.1.1.3 Garden furniture
5.1.2.1 Soft floor coverings
5.1.2.2 Hard floor coverings
5.2.1 Bedroom textiles including duvets and pillows
5.2.2 Other household textiles, including cushions, towels, curtains
5.3.1 Gas cookers
5.3.2 Electric cookers, combined gas/electric cookers
5.3.3 Clothes washing machines and clothes drying machines
5.3.4 Refrigerators, freezers and fridge freezers
5.3.5 Other major electrical appliances e.g., dish washers, microwaves, vacuum cleaners, heaters
5.3.6 Fire extinguishers
5.3.7 Small electric household appliances
5.3.8 Spare parts for appliances and repairs
5.3.9 Rental/hire of major hhold appliances
5.4.1 Glassware, china, pottery, cutlery and silverware
5.4.2 Kitchen and domestic utensils
5.4.3 Repair of glassware, tableware and household utensils
5.4.4 Storage and other durable household articles
5.5.1 Electrical tools
5.5.2 Garden tools, equipment and accessories
5.5.3 Small tools
5.5.4 Door, electrical and other fittings
5.5.5 Electrical consumables
5.6.1.1 Detergents, washing-up liquid, washing powder
5.6.1.2 Disinfectants, polishes, other cleaning materials, some pest controls
5.6.2.2 Household hardware and appliances, matches
5.6.2.3 Kitchen gloves, cloths etc
5.6.2.4 Pins, needles, tape measures, nails, nuts and bolts

5.6.3.1 Domestic services including cleaners, gardeners, au pairs
5.6.3.2 Carpet cleaning, ironing service and window cleaner
5.6.3.3 Hire/repair of household furniture and furnishings

6. Health
6.1.1.1 NHS prescription charges and payments
6.1.1.2 Medicines and medical goods (not NHS)
6.1.1.3 Other medical products
6.1.1.4 Non-optical appliances and equipment
6.1.2.1 Purchase of spectacles, lenses, prescription sunglasses
6.1.2.2 Accessories/repairs to spectacles/lenses
6.2.1.1 NHS medical, optical, dental and medical auxiliary services
6.2.1.2 Private medical, optical, dental and auxiliary services
6.2.1.3 Other services
6.2.2 In-patient hospital services

7. Transport
7.1.1.1 New cars/vans outright purchase
7.1.1.2 New cars/vans loan/HP purchase
7.1.2.1 Second-hand cars/vans outright purchase
7.1.2.2 Second-hand cars/vans loan/HP purchase
7.1.3.1 Outright purchase of new or second-hand motorcycles
7.1.3.2 Loan/HP purchase of new or second-hand motor cycles
7.1.3.3 Purchase of bicycles and other vehicles
7.2.1.1 Can/van accessories and fittings
7.2.1.2 Car/van spare parts
7.2.1.3 Motorcycle accessories and spare parts
7.2.1.4 Bicycle accessories and spare parts
7.2.2.1 Petrol
7.2.2.2 Diesel oil
7.2.2.3 Other motor oils
7.2.3.1 Car of van repairs, servicing and other work
7.2.3.2 Motor cycle repairs and servicing
7.2.4.1 Motoring organisation subscription
7.2.4.2 Garage rent other costs, car washing
7.2.4.3 Parking fees, tolls and permits
7.2.4.4 Driving lessons
7.2.4.5 Anti-freeze, battery water, cleaning materials
7.3.1.1 Rail and tube season tickets
7.3.1.2 Rail and tube other than season tickets
7.3.2.1 Bus and coach season tickets
7.3.2.2 Bus and coach other than season tickets
7.3.3.1 Combined fares other than season tickets
7.3.3.2 Combined fares season tickets
7.3.4.1 Air fares within UK
7.3.4.2 Air fares international
7.3.4.3 School travel
7.3.4.4 Taxis and hired cars with drivers

7.3.4.5 Other personal travel and transport services
7.3.4.6 Hire of self-drive cars, vans, bicycles
7.3.4.7 Car leasing

8. Communication
8.1 Postal services
8.2.1 Telephone purchase
8.2.2 Mobile phone purchase
8.2.3 Answering machine, fax machine purchase
8.3.1 Telephone account
8.3.2 Telephone coin and other payments
8.3.3 Mobile phone account
8.3.4 Mobile phone other payments
8.4 Internet subscription fees

9. Recreation and Culture
9.1.1.1 Audio equipment, CD players incl. in car
9.1.1.2 Audio accessories e.g., tapes, CDs, headphones
9.1.2.1 Purchase of TV and digital decoder
9.1.2.2 Satellite dish purchase and installation
9.1.2.3 Cable TV connection
9.1.2.4 Video recorder
9.1.2.5 DVD player/recorder
9.1.2.6 Blank, pre-recorded video cassettes and DVDs
9.1.2.7 Personal computers, printers and calculators
9.1.2.8 Spare parts for TV, video, audio
9.1.2.9 Repair of AV
9.1.3.1 Photographic and cine equipment
9.1.3.2 Camera films
9.1.3.3 Optical instruments, binoculars, telescopes
9.2.1 Purchase of boats, trailers and horses
9.2.2 Purchase of caravans, mobile homes
9.2.3 Accessories for boats, horses, caravans and motorhomes
9.2.4 Musical instruments
9.2.5 Major durables for indoor recreation
9.2.6 Maintenance and repair or other major durables for recreation and culture
9.2.7 Purchase of motor caravan - outright purchase
9.2.8 Purchase of motor caravan - loan/HP
9.3.1 Games, toys and hobbies
9.3.2.1 Computer software and games cartridges
9.3.2.2 Console computer games
9.3.3 Equipment for sport, camping and open-air recreation
9.3.4.1 BBQ and swings
9.3.4.2 Plants, flowers, seeds, fertilisers, insecticides
9.3.4.3 Garden decorative
9.3.4.4 Artificial flowers, pot pourri
9.3.5.1 Pet food
9.3.5.2 Pet purchase and accessories

9.3.5.3 Vetinary and other services for pets
9.4.1.1 Spectator sports - admission charges
9.4.1.2 Participant sports
9.4.1.3 Subscriptions to sorts and social clubs
9.4.1.4 Hire of equipment for sport
9.4.1.5 Leisure class fees
9.4.2.1 Cinemas
9.4.2.2 Live entertainment, theatre, concerts, shows
9.4.2.3 Museums, zoological gardens, theme parks
9.4.3.1 TV licences
9.4.3.2 Satellite subscriptions
9.4.3.3 Rent for TV/Satellite/VCR
9.4.3.4 Cable subscriptions
9.4.3.5 TV slot meter payments
9.4.3.6 Video, cassette and CD hire
9.4.4.1 Admissions to clubs, dances. Discos, bingo
9.4.4.2 Social events and gatherings
9.4.4.3 Subscriptions for leisure activities
9.4.5 Development of film, photos
9.4.6.1 Football pools stakes
9.4.6.2 Bingo stakes
9.4.6.3 Lottery
9.4.6.4 Bookmaker, tote, other betting stakes
9.5.1 Books
9.5.2 Diaries, address books, cards etc
9.5.3 Cards, calendars, posters and other printed matter
9.5.4 Newspapers
9.5.5 Magazines and periodicals

10. Education
10.1 Education
10.2 Educational trips

11. Restaurants and Hotels
11.1.1 Restaurant and café meals
11.1.2 Alcoholic beverages
11.1.3 Takeaway meals
11.1.4.1 Hot food and cold food
11.1.4.2 Confectionery
11.1.4.3 Ice cream
11.1.4.4 Soft drink
11.1.5 Contract catering
11.1.6.1 School meals
11.1.6.2 Meals bought in workplace
11.2.1 Holiday in the UK
11.2.2 Holiday abroad
11.2.3 Room hire

12. Miscellaneous Goods and Services
12.1.1 Hairdressing, beauty treatment
12.1.2 Toilet paper
12.1.3.1 Toiletries
12.1.3.2 Bar of soap, liquid soap, shower gel
12.1.3.3 Toilet requisites
12.1.4 Baby toiletries and accessories
12.1.5.1 Hair products
12.1.5.2 Cosmetics and related accessories
12.1.5.3 Electrical appliances for personal care
12.2.1.1 Jewellery clocks and watches and other personal effects
12.2.1.2 Leather and travel goods
12.2.1.3 Sunglasses
12.2.2.1 Baby equipment
12.2.2.2 Prams, pram accessories
12.2.2.3 Repairs to personal goods
12.3.1.1 Residential homes
12.3.1.2 Home help
12.3.1.3 Nursery, creche, playschools
12.3.1.4 Child care payments
12.4.1.1 Structure insurance
12.4.1.2 Contents insurance
12.4.1.3 Insurance for household items
12.4.2 Medical insurance premiums
12.4.3.1 Vehicle insurance
12.4.3.2 Boat insurance
12.4.4 Non package holiday, other travel insurance
12.5.1.1 Moving and storage of furniture
12.5.1.2 Property transaction - purchase and sale
12.5.1.3 Property transaction - sale only
12.5.1.4 Property transaction - purchase only
12.5.1.5 Property transaction - other payments
12.5.2.1 Bank building society fees
12.5.2.2 Bank and post office counter charges
12.5.2.3 Credit card fees
12.5.3.1 Other professional fees
12.5.3.2 Legal fees
12.5.3.3 Funeral expenses
12.5.3.4 TU and professional organisations
12.5.3.5 Other payments for services