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Open Finance and Carbon Neutral Banking: Leveraging Financial Transaction Data for Consumers Carbon Footprint Measurement

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Open Finance and Carbon Neutral Banking: Leveraging Financial Transaction Data for Consumers' Carbon Footprint Measurement

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Abstract: Recent industry insights show that banks still face significant constraints in measuring indirect Green House Gas (GHG) emissions owing to data limitations and a lack of harmonised methodologies. At the same time, banks and other financial institutions hold large volumes of consumer data that can be leveraged to estimate GHG emissions albeit financial transaction data are privately owned with restricted access. This paper discusses how an open finance framework can be used to aggregate consumer transaction data across multiple financial products to compute carbon footprints. It highlights a step-by-step approach to carbon footprint estimation and discusses the consideration for using microdata for emission computation.

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1. Problem Statement

Office for National Statistics (ONS) estimates suggest that the UK has witnessed a decline in Green House Gas (GHG) emissions relative to 1990 levels. However, consumption-based emissions continue to fall at a slower rate compared with territorial- and production-based emissions[1]. UK territorial GHG emissions have declined by 52% since 1990, compared with 39%, and 36% for production- and consumption-based emissions respectively.[2] Consumption-based GHG emissions (emissions attributed to the consumption of goods and services) have been highlighted by the House of Commons Energy and Climate Change Committee as having huge potential to complement existing carbon accounting methodologies adopted in the UK for monitoring and evaluating carbon footprints.[3] The Parliamentary Office of Science and Technology defines carbon footprint as “the total amount of CO_2 and other greenhouse gases, emitted over the full life cycle of a process or product.[4] It is expressed as grams of CO_2 equivalent per kilowatt hour of generation (gCO_2eq/kWh), which accounts for the different global warming effects of other greenhouse gases." Insights into consumers’ carbon footprints will allow for a better understanding of the drivers of climate change from a consumer perspective [1].

Consumption-based emission estimates are gaining increasing attention owing to their ability to enable consumers to understand their carbon footprints and take the necessary steps to offset them. Consumption-based emission estimates hold substantial climate mitigation potential that can be achieved through changes in behavioural choices [2].

Achieving a global temperature limit of below 2°C and a target of 1.5°C in line with the Paris Agreement will require ambitious actions and commitment from all stakeholders, including financial institutions. Financial institutions will need to adjust their business models and strategies using science-based targets and action plans. They are equally expected to play major roles in the transition to a net-zero economy through lending and financing decisions, while at the same time supporting the transition of their clients.[5] It is against this backdrop that the United Nations Environmental Programme Finance Initiative (UNEP FI) has developed Guidelines on Climate Target Setting for Banks through its Collective Commitment to Climate Action (CCCA) programme.[6] Signatory banks to this initiative are required to set, at a minimum, a 2030 target and a 2050 target to achieve their climate transition goals in line with the Paris Agreement and, where data allows, such targets shall cover their clients’ emissions [3].

A study by Deloitte reveals that about 85% of banks are committed to achieving climate neutrality. While financed emissions account for about 75% of the carbon footprint for banks, they are difficult to measure. Specifically, banks still face significant challenges in measuring indirect GHG emissions (Scope 3 emissions. i.e., indirect emissions in value chains, including emissions of consumers) due to data

[1] Green House Gas Emissions (GHGs) are reported in the UK in three main ways: territorial, production and consumption-based approaches. Refer to the literature review section for description of these approaches.
[2] https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/measuringukgreenhousegasemissions#:~:text=Footprint%20(consumption)%20emissions%20cover%20consumption,a%2036%25%20reduction%20since%201990.
[3] https://publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1646/1646vw.pdf.
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[6] https://www.unepfi.org/wordpress/wp-content/uploads/2021/04/UNEP-FI-Guidelines-for-Climate-Change-Target-Setting.pdf.

limitations and a lack of harmonised methodologies.

Consumers' financial transaction data can be leveraged to inform the computation of carbon footprints, but such datasets are commercially owned and not publicly available owing to privacy laws [4]. By combining data with technology, financial institutions can provide consumers with real-time estimates of their carbon footprints and integrate innovative solutions to trigger behavioural changes, while providing carbon offsetting products to consumers. Innovative solutions are beginning to emerge in this domain, including carbon calculators [5], but the restricted access to transaction data implies that such solutions can only provide partial carbon estimates with limited impact, especially given that consumers are likely to have multiple accounts with different financial institutions. Household and questionnaire survey approaches to carbon footprint estimations are attractive due to their representativeness, but they suffer from a low frequency of data collection and may put a significant burden on consumers in filling out questionnaires [4].

Our paper discusses how open banking, and open finance can facilitate access to consumer transaction data across multiple providers, leading to a comprehensive estimate of carbon footprints and carbon offsetting solutions. Open banking under the EU's Payment Services Directive (PSD2) enables consumers to grant third-party providers (TPPs) permission to access their payment account information for tailor-made solutions or to make payments on their behalf [6]. Open banking facilitates the sharing of consumers' financial data with TPPs through consumer consent. The Payment Services Regulations 2017 (PSRs) consequently grant TPPs the legal right to access consumer financial information provided they have their explicit consent [6]. According to the Financial Conduct Authority (FCA), the PSRs have brought about three main entry points for financial innovation based on consumer data [6]:

1. Account Information Service (AIS), which enables consumers to view the accounts they hold with different banks in one place.

2. Payment Initiation Service (PIS), which enables consumers to make direct payments from their bank accounts without the need to use debit or credit cards.

3. Card Based Payment Instrument Issuers (CBPIIs), which enable consumers to access alternative payment cards outside their banks.

The data-sharing potential of open banking presents an opportunity for carbon-neutral banking. However, the current data-sharing arrangement under open banking is limited in scope. Open finance is therefore gaining increasing attention as a mechanism to broaden the scope of data sharing and facilitate innovation [7]. Open finance as a concept seeks to go beyond open banking and extend consumers' ability to share data with TPPs from multiple sources, including savings, mortgages, consumer credit, investments, pensions, and insurance [6]. Within this context, TPPs, with the help of Application Programme Interfaces (APIs), can access a wide range of consumer data [8]. The availability of new forms of data through open finance is expected to help TPPs and financial firms provide real-time carbon footprint estimates which can form the basis for consumer behavioural change towards the environment [5].

In the sections that follow, this paper discusses existing approaches to carbon footprint estimation and highlights how such approaches can be enhanced by leveraging consumers' financial transaction data. The paper views open banking as a starting point for powering climate transition goals and open finance as a superior pathway through which such transition can be achieved.

2. Literature Review

2.1 Measuring Greenhouse Gas (GHG) Emissions

In this paper, we focus on the consumption-based emission approach to the computation of carbon footprints, but we first provide a brief description of other techniques for the measurement of carbon footprints. Prior research has identified three main approaches by which GHG emissions can be allocated to a country or region [9]:

i. Territorial-based emissions inventories.

This approach is consistent with the United Nations Framework Convention on Climate Change (UNFCCC) where annual National Emission Inventories are required to be submitted following the guidelines of the Intergovernmental Panel on Climate Change. This approach captures the emissions within national boundaries and offshore areas under a country's jurisdiction. However, GHG emissions that occur in international territory, international aviation, and shipping are not allocated to individual countries.

ii. Production-based emission inventories

In the UK, for example, this method is used to measure emissions caused by UK residents and industry either internally or abroad but excludes emissions in the UK that are caused by overseas residents and businesses, including those originating from land use or changes in land use and forestry.

iii. Consumption-based emission inventories.

This approach is employed to allocate emissions to final consumers in a country. Consumption-based emission can be conceptualised as follows: Consumption = production – exports + imports. In the UK, for example, these estimates are computed by the University of Leeds and published by the Department for Environment, Food and Rural Affairs [9].

2.2 Consumption-based emissions accounting

The consumption-based emissions accounting method is a demand-side approach that computes both the direct and indirect emissions attributable to the final consumer, including households, governments, and capital at the end of the supply chain [10]. Final consumers can decrease their carbon footprint through demand-side behavioural changes, such as a change in consumption patterns [10].

Input-output (IO) analysis stands out as an approach to carbon footprint estimation under the consumption-based methodology. IO analysis is a macroeconomic approach that accounts for the complex interdependence of industries using data on inter-industrial monetary transactions [11]. In this case, industrial emission intensity estimates are obtained from input-output tables and subsequently mapped to household consumption expenditures [12]. This approach is mostly used by environmental economists to estimate the environmental impact of production and consumption [9].

A common IO analysis that has gained popularity in the literature is the Environmental Extended Multi-Regional Input–Output (EE-MRIO) analysis. This approach is suitable for complex analysis and splitting trade flows into intermediate and final consumption and in the reallocation of emissions to consumers. It is also favoured because it represents a measure that accounts for global emissions. EE-MRIO makes it possible to compute carbon footprints while accounting for GHG emissions from the full supply chain of production anywhere in the world to the point of final consumption [9]. However, consumption-based measures are prone to high uncertainties, especially during the reallocation of emissions from technologies to sectors and due to the inclusion of imports [13].

Prior research has employed an input-output model to estimate the direct and indirect CO_2 emissions of consumption patterns of different lifestyle groups in the UK [14], with the evidence suggesting that consumption choices account for about 75% of consumer CO_2 emissions. Variations in CO_2 emission across lifestyle groups are also driven by differences in consumption choices, with the largest share attributed to transport and housing-related expenditures.

Related research also employed input-output analysis with expenditure data to estimate energy use in the city of Sydney, Australia [11]. The evidence reveals that differences in lifestyle lead to different energy use patterns in the inner and outer areas of the city. The evidence further points to a significant relationship between energy use and other characteristics, such as income, household size, age, and degree of urbanity. Another study in the UK based on the IO technique shows that large energy-water-food footprints are attributable to the final consumption of the services sector, construction, and agricultural products [15]. Demand-side strategies are believed to be an effective way to reduce overall consumption of goods and services [15]. Relevant literature suggests that about 90% of the human settlements in the UK are net importers of CO_2 emissions [16], with evidence indicating that socio-economic factors such as income, education, and car ownership rather than geographic and infrastructural factors drive CO_2 emissions in cities and settlements in the UK [16].

3. Solution framework

3.1Carbon footprint estimation using financial transactions data

Recent research documents three main approaches that can be used to allocate carbon emissions to individual-level or household-level activity [4]. The first approach is to estimate carbon footprints using spend data from nationally representative surveys and carbon emission factors derived from EE-MRIO tables. However, household surveys have significant limitations, such as small sample sizes and low frequency of data collection. A second approach also uses surveys to capture specific activities of consumers with known physical quantities of emissions. While this approach provides individual estimates of emissions, completing questionnaires daily may be time-consuming and result in low levels of participation. Moreover, information obtained through this approach is not representative of the population, and the self-reported nature of the survey may give rise to biased estimates. A third approach is to combine financial transaction data with data from nationally representative surveys and EE-MRIO tables. The use of financial transaction data makes it possible for emission estimates to be produced in real-time.

Figure 1 presents the steps involved in estimating individual-level carbon footprints based on the study by Trendl et al [4]. The first step requires the computation of the carbon equivalent of GHG to capture the direct and indirect emissions resulting from the production of goods and services. These estimates are categorised using the United Nations Classification of Individual Consumption According to Purpose (COICOP) system. The COICOP is an international classification system which is based on the classifications of consumption expenditures and is part of the Systems of National Accounts. The COICOP 2018, for example, has a four-level coding system (Division, Group, Class, and Subclass levels) with 15 categories at the Division level, 63 at the Group level, 186 at the Class level, and 338 at the Subclass level.[7]

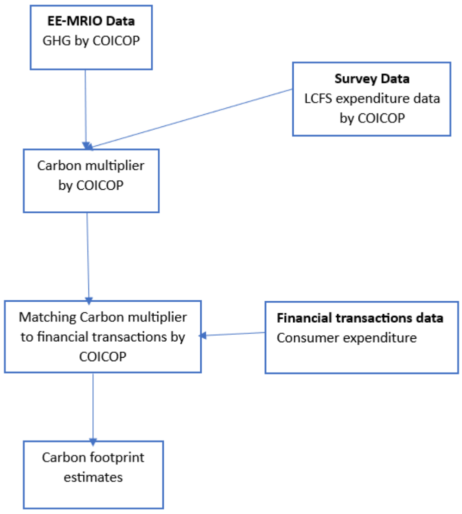

Figure 1. Carbon Footprint Estimation Using Financial Transaction Data

Source: Adopted from Trendl et al (2022) with modifications

The second step involves the computation of a carbon multiplier, which is defined as the GHG emissions per £1 unit of spending in each COICOP category. The idea here is to convert consumer expenditure to an equivalent level of emissions. This is possible by using expenditure data from a nationally representative survey to ensure that emission estimates are representative of the population. The Living Costs and Food Survey, which is conducted by the Office for National Statistics of the UK, provides data on spending patterns and the cost of living across the UK and has become a useful source of information on household expenditures. Luckily, data on GHG emissions by COICOP and their equivalent carbon multipliers (carbon

[7] https://unstats.un.org/unsd/classifications/Econ/Download/COICOP_2018_draft_publication.pdf.

conversion factors) are made available by the Department for Environment, Food and Rural Affairs which can be leveraged by financial institutions to compute the carbon footprints of consumers.

The third step requires matching carbon multipliers to financial transactions by COICOP. This can be achieved by classifying financial transaction data in the same way as the carbon multipliers using the COICOP system. Alternatively, financial institutions can map their internal classification of financial transactions under respective COICOP. Finally, the carbon footprint of consumers can be estimated by multiplying individual expenditure data as captured in their financial records (£) by the carbon multipliers by COICOP categories [4].

3.2 Enhancing carbon footprint estimation through open finance data

Open banking offers financial institutions and TPPs the opportunity to aggregate consumers' financial data from multiple accounts to deliver tailor-made solutions. However, the provision of open banking services has been limited to payments, current accounts, and credit applications. Open finance is therefore expected to build on the same data-sharing principles of open banking by extending data-sharing arrangements to savings, mortgages, consumer credits, investments, and pensions.[8]

Figure 2 shows how open banking and open finance data can be leveraged to provide comprehensive estimates of consumer carbon footprint. Building on Trendl et al [4], Figure 2 provides an extended framework for carbon footprint estimation by integrating open banking and open finance data. This framework enables financial institutions and TPPs to aggregate open banking data that is made possible through AIS, PIS, and CBPIIs. Via APIs, open banking data can be combined with financial data from savings, mortgages, consumer credits, investments, and pensions, which together constitute open finance data. Open finance data can be expressed in expenditure terms and categorised by COICOP to simplify the process of carbon conversion using carbon multipliers.

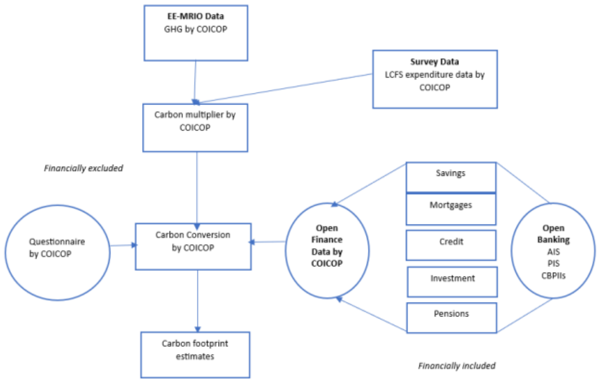

Figure 2. Enhanced framework for carbon footprint estimation using open finance data.

Source: Framework of Trendl et al (2022) is modified to accommodate open banking and open finance data.

The use of carbon finance data for carbon footprint estimation only applies to consumers who are financially included, in this case consumers who have access to open finance services, including open banking and banking services. This is captured by the right side of Figure 2. Carbon estimations based on open finance data will exclude consumers who do not have access to open finance services. The left side of Figure 2 provides an alternative solution for the financially excluded. Carbon calculators that only require consumers to complete a questionnaire to reflect their consumption patterns will go a long way to help the financially excluded segment of consumers. A questionnaire-based carbon footprint calculator, for example, has been designed by the European Union to capture the environmental impacts of consumers [5]. This approach can be replicated by financial institutions and TPPs to allow prospective customers and the financially excluded to assess their carbon footprints using online questionnaire-based calculators.

Financial institutions are beginning to leverage financial transaction data to provide consumer carbon footprints. NatWest, for example, has partnered with Cogo to provide carbon footprint estimates for consumers through their banking app. The carbon footprint tracker

[8] https://www.openbanking.org.uk/open-finance/.

comes with an educational component on how consumers can reduce their carbon footprints. Greenly has also partnered with Tink to aggregate bank account transaction information of consumers across Europe and quantify the carbon footprint of consumers based on their purchases. Sugi has recently launched its carbon offsetting solution that enables investors to check the carbon footprint of their investment portfolio. In partnership with Ecosphere+, Sugi offers investors the chance to offset their carbon footprint through carbon credit.

The emerging technology solutions using financial data prove that achieving carbon-neutral banking by empowering consumers with knowledge of their carbon footprint is possible. However, the full potential of consumer data can be unlocked through open finance.

4. Considerations for using microdata

A recent study evaluates the extent to which the choice of microdata can influence emission estimates in the UK [17]., and proposes possible factors to consider when choosing a micro dataset for carbon footprint computation. The first factor to consider is knowledge and transparency about the data generation process. This is particularly important as any uncertainty embedded in the microdata directly influences the accuracy of the emission estimates. An open discussion of available datasets including uncertainties and limitations will contribute to a better understanding of carbon footprint estimations [17] .

The second factor to consider is the level of aggregation of emission estimates. While disaggregation can be carried out at the household level, income level, community level, or product level, attention has to be paid to the data requirements and the uncertainties associated with each level of disaggregation [17]. Third, special attention also needs to be given to the way expenditure is captured in the dataset to understand potential sources of bias [17]. Consumption-based emission measurements should account for regional differences in expenditure arising from variation in prices and not necessarily higher consumption. This challenge can be addressed by complementing expenditure data with physical measurement. For example, the number of rooms can be used as a physical measure of accommodation rather than a financial measure such as rents, which is more susceptible to regional price variations [17]. Finally, the target audience of the emission estimates should be considered [17].

5. Conclusion

Financial institutions can play an essential role in enabling countries to achieve the global temperature limit of below 2°C and a target of 1.5°C in line with the Paris Agreement. While the measurement of carbon footprint is viewed as a possible way to benchmark the attainment of the Paris Agreement, significant challenges remain regarding the availability and quality of data. At the same time, large volumes of financial transaction data exist that can be leveraged to provide insights into consumers' carbon footprints, but these datasets are commercially owned and not publicly available. Open finance provides an important avenue to facilitate access to consumer financial data across multiple providers, thereby enabling comprehensive estimation of carbon footprints. Carbon footprints are not only expected to lead to behavioural changes among consumers but also open the door for carbon offsetting solutions.

Open finance holds great promise to support consumption-based emission estimation efforts, but attention must be paid to potential challenges that may come with open finance. Given that data sharing under open banking and by extension open finance is dependent on consumer consent, a proper system should be designed to accommodate the management of consumer consent from multiple sources. Also, carbon footprint estimates should come with information on potential sources of bias to enable a better understanding of carbon footprints [18]. Importantly, consumers should be given carbon incentives, such as financial rewards. to encourage the sharing of financial data in support of carbon footprint calculation.

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