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Make carbon footprints available – And it is not just one value

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ABSTRACT

The carbon footprint (CF) should finally have a role in the decision-making of manufacturing companies, retailers, public procurers and consumers. We consider that more systematic approaches are urgently needed for collecting, storing and presenting carbon footprint information. The key issue from the standpoint of reliability and comparability is to recognise how each CF was determined and how it has been verified. Global Trade Item Number (GTIN) and the connected barcode symbol can be used to identify products. We propose that the presented framework can help to build databases which are easy to use for the manufacturers, retailers and various service providers and which can increase the production and usability of CF information.

1. Introduction

Carbon footprint (CF) values have been called for to help consumers, public procurers and companies to make low-carbon choices. Ten years ago, in 2011, Vandenbergh et al. (Vandenbergh et al., 2011) proposed that a global private carbon-labelling scheme for consumer products could fill the climate-policy gap by influencing the behaviour of consumers and corporate supply chains: 'the value of the label comes not from providing perfect information, but better information than the consumer has at present.' The large UK retail chain Tesco declared in 2007 that they will show the CFs for all their 70 000 products (The Guardian, 2008).

Now, a decade later, one sees many different claims or labels about carbon or climate neutrality (Rogelj et al., 2021), but the actual CFs, let alone their scope and calculations, are rarely shown. Tesco dropped its labelling plan in 2012 (The Guardian, 2012). However, people are still interested, and they claim that they would appreciate CF information; international consumer research from 2020 showed that two-thirds of consumers supported carbon labelling (Carbon Trust, 2020). In the EU, 60% of the respondents had taken some personal action to fight climate change by 2019, an 11% increase over 2017 (Special Eurobarometer, 2019).

We see that the problem is in the incomparability of CF values. The CF standard ISO 14067:2018 doesn't determine the calculations in a way that would produce comparable results within a product category, like t-shirts or meatballs. What follows is that there is a need for 'information on the CF', in order to judge how the CF value can be used for several purposes. Further, there should be commonly used databases to store the CF values and related information.

We consider herein what kinds of developments are needed. We approach this via three questions: 1) What are the needs of various users in terms of the quality of CF information? 2) What information about the CF is most relevant to evaluate the quality? 3) What kind of database would facilitate easy access to relevant CF information?

2. The needs of various users differ in terms of the quality of CF information

The retail sector has to deliver accurate, truthful and reliable information to consumers (Directive 2005/29/EC, 2005). In public procurement, the tender competition must be fair and transparent, for example, the CFs of competing products need to be determined using the same method (Directive 2014/24/EU, 2014).

There are also actors that deliver approximate CF information to consumers. Many are 'service providers' offering, for example, a personal CF calculator[1], a green bonus card or credit card. For example, CF calculators for citizens show which consumption sectors and choices cause the largest emissions, and for many products, CF data are obtained from environmentally extended input–output (EIO) models (Salo et al., 2019). The EIO approach provides estimates for broad product and service groups like 'textiles' and 'furniture' (Seppälä et al., 2011). Also

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[1] Examples of calculators: https://www3.epa.gov/carbon-footprint-calculator/, https://climatediet.fi/ (accessed 2 June 2021).

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'green credit cards', such as the Baltic Sea Card (2021), and many retailer loyalty schemes base CF calculations on EIO data.

3. Identifying the most relevant information about the CF to evaluate its quality

The key issue from the standpoint of reliability and comparability is to recognise how each CF was determined. The CF standard (ISO 14067:2018) is a reasonable starting point for CF measurement. However, even if the standard is followed, there are many possibilities to make subjective choices in CF assessments (like in Life Cycle Assessments (LCAs) (Galatola and Pant, 2014)). There can be differences in terms of e.g. data sources, allocation and cut-off criteria. Category-specific rules – such as those in the Product Environmental Footprint (PEF) and the Environmental Product Declaration (EPD) schemes (European Commission, 2020; EPD, 2021) – improve the comparability of different CFs. However; such schemes are only available for a few product categories.

On the other hand, there are also CF assessments based on LCA rules, but instead of doggedly following the rules, they try to get appropriate results in cost-effective ways. They can be hybrid analyses using data from both product-specific CF assessments and EIO analyses, or they can focus on the most important stages of the product life cycle.

In summary, we can identify several different methods for assessing the CF of products: (1) a product-specific CF value, based on PEFCRs (the category rules of a PEF); (2) a product-specific CF value, based on the EPD scheme and product category rules (PCRs); (3) a product-specific CF value, based on the CF standard (ISO 14067:2018); (4) a simplified CF; and (5) a CF value for the product group, resulting from EIO analysis.

The reliability of the CF can be increased by an external standardised review. According to ISO 14067, a critical review facilitates understanding and enhances the credibility of the CF value, and there is a standard for the review (ISO/TS 14071). In addition, there are rules for the third-party audit or verification in the EPD and PEF schemes (Ernst & Young et Associés, 2017). We can identify several different verification methods: (A) third-party audit/verification, based on the PEFCRs in a PEF scheme; (B) third-party audit/verification, based on the PCRs in an EPD scheme; (C) a third-party critical review (used for LCAs and CFs); (D) other verification methods (which need to be specified); and (E) no verification method.

4. Which components of the CF should be shown?

It is important to specify which greenhouse gas (GHG) emissions or removals are included in the CF assessments. The standard ISO 14067 defines the components of a CF: it involves seven different GHG emission components and five different removals of GHGs from the atmosphere, which can exist in five life cycle phases, namely, raw material acquisition (R), production (P), distribution (D), use (U) and end-of-life treatment (E).

For most users, it perhaps is not relevant to know all the different emissions and removals of GHGs in each life cycle stage. That is why we propose summing up the emissions and removals for each relevant life cycle phase. And finally, it is the 'total carbon footprint' for which most services and data users wait.

Additionally, it is possible to calculate the data quality score according to the PEF methodology (European Commission, 2018), which can also be applied to the other kinds of assessments like CF. The score takes into account, for example, the specificity of the data for each life cycle phase (i.e. how up to date the data is and whether the input data is from a specific production chain or from generic, secondary sources).

5. What kind of database would facilitate easy access to the relevant CF information?

It is evident that Digital Product Passports will help in the transfer of environmental data between companies (European Commission, 2021), but compiled data (i.e. product databases) are needed regardless of this (Adisorn et al., 2021) (e.g. for retailers and different service providers). In order to have a source of data which all kinds of service providers could easily use, the identification of products is an issue that needs to be solved. Globally, both retailers and suppliers use the Global Trade Item Number (GTIN) and the connected barcode symbol to identify products (Economy, 2289). In order to study the possibility of linking the CF to GTIN codes, and in this way, increasing the usability of CF information, in spring 2020 we discussed our approach (that which is now formally described in this paper) with the organisation GS1 Finland, GS1 being the organisation that globally develops and maintains GTIN codes and other global standards for business communication. The discussion about this approach in GS1 is currently still

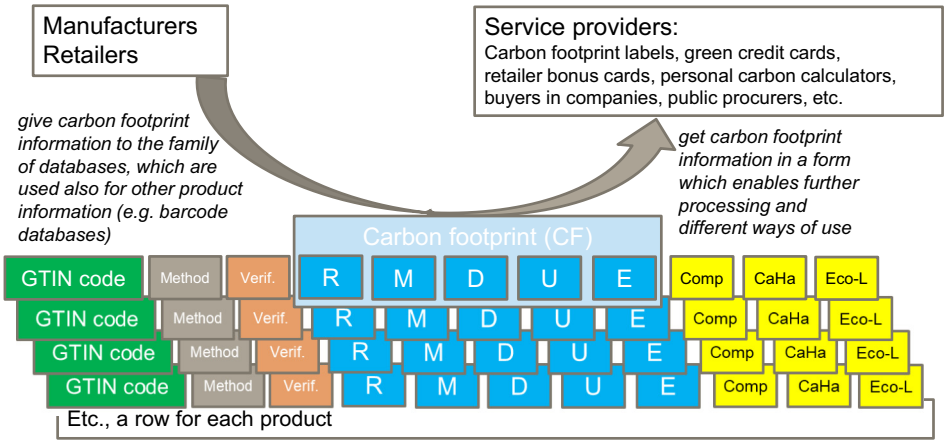

Fig. 1. An information system with easy access to both information producers (manufacturers and retailers) and information users (service providers) that aims to increase the usability of CF information for the eco-design of low-carbon products and services, and finally, increase the respective consumer choices. *GTIN code* means the product identifier (e.g. in European Article Number (EAN) or Universal Product Code (UPC) barcode databases). Next, the CF method (*Method*) and the verification method (*Verif.*) are shown. The GHG-emission values are given for the phases of the life cycle (*R, M, D, U* and E), and in total, they can be aggregated to reach the actual CF value of the product. However, partial CF values can also be produced from the values of the phases, for example, the 'to the gate' value (R-M). There is also space for the information about compensation (*Comp*), carbon handprint (*CaHa*) and type 1 eco-labels (*Eco-L*) if that information exists for the product. In addition to the elements shown in the figure, it is good to include e.g. the data quality score and a link to the CF study report.

going on internationally. However, the principles presented here can be applied to any product database.

By using the information, different service providers could decide whether or not to accept a piece of data for their services. They could also use the information to, for example, give uncertainty intervals to the CF values.

Fig. 1 shows the flow of relevant CF data between the producers and users of the CF data. In order to establish this framework, there is a need for a database or databases (e.g. GS1 has inter-connected databases) which have a product identifier system in place and which the manufacturers and retailers could use to store and distribute their information.

The challenges include for example: 1) Will the manufacturers discover the database and recognise it? The connection to the commonly used GTIN and barcode will most probably help in this. 2) How the manufacturers see the need to choose the CF method, will they be too indecisive to proceed? 3) Will the manufacturers and retailers be in favour of granting access to their CF values in the database to several types of users, not restricting it too much. However, we see that this framework can help to build databases which are easy to use for the manufacturers, retailers and various service providers and which increase the production and usability of CF information.

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CRediT authorship contribution statement

Ari Nissinen: Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Visualization. **Jyri Seppälä:** Writing – review & editing, Funding acquisition. **Tero Heinonen:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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