CARBON FOOTPRINT CALCULATORS FOR PUBLIC PROCUREMENT OF SIX PRODUCT GROUPS

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ABSTRACT. There is growing interest among public organizations in taking into account the climate impacts of the products and services they procure. We developed six product-group-specific carbon footprint tools that can be used in tender competitions. These calculators, based on the life-cycle approach, can be downloaded free of charge. The tools cover the following products: office and tissue paper, laptop computers, office chairs, incontinence products, and outdoor lighting products. The calculation of the carbon footprint requires information about amounts of various materials in the product, energy use during the final manufacturing or assembly process, and energy use in the use stage, along with data on the modes and distances of transportation. The paper describes a case in which a tool for IT products was used for a call for tenders in autumn 2011. Finally, the relevance and impact of the carbon footprint criterion in the award process are analyzed and discussed.

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INTRODUCTION

The public sector is an important consumer, representing around 19% of gross domestic production in the European Union (European Commission, 2012). Local authorities are important purchasers capable of setting an example in procurement of products that are sustainable from the perspective of reduction of greenhouse gas emissions. In Finland, also the government resolution on sustainable public procurement offers some framework for this work and sets aims for it. Additionally, global greenhouse gas emission reduction goals encourage green public procurement.

Green public procurement (GPP) is a process wherein environment-related criteria are taken into account in procurement of goods, services, and work (European Commission, 2012). Green approaches in combination with life-cycle thinking in public procurement are adopted and studied increasingly (e.g., Tarantini *et al.*, 2011; Parikka-Alhola & Nissinen, 2012; Hochschorner & Finnveden, 2006).

In 2009–2011, several municipalities in the Helsinki region collaborated with the Helsinki Region Environmental Services Authority and diverse expert organizations in an EU LIFE+ project, Julia 2030, to develop calculators for use in various sectors of municipalities' operations – e.g., waste management and public transportation. One of these sectors is public procurement.

This paper introduces the calculators developed for assessing the carbon footprint of products during a public procurement process. In addition, we describe an actual call for tenders in which the IT calculator was used. We then discuss the relevance and impact of the carbon footprint criteria in the award process.

METHODS

Life Cycle Thinking and Carbon Footprint

Life-cycle assessment (LCA) is a mature and accurate methodology for assessing the environmental impacts of a given product or system. It considers the entire product life cycle: raw materials' acquisition, production, use, and the end-of-life stage. Generally, LCA has four analysis stages: goal and scope definition, life-cycle inventory, impacts' assessment, and interpretation of the results. After the goal and scope are well defined, the alternatives can be judged on a sound comparative basis, often defined as the functional unit (JRC, 2010).

Today, carbon footprint (CF) is a well-known example of an approach in which only climate impacts, assessed in terms of life-cycle assessment methodology, are considered. Product carbon footprint (PCF) can be defined as follows: "Greenhouse gas emissions for a product across its life cycle, from raw materials through production (or service provision), distribution, consumer use and disposal/recycling. It includes the greenhouse gases carbon dioxide, methane and nitrous oxide, together with families of gases including hydrofluorocarbons and perfluorocarbons" (IPCC, 2007). Typically, PCF is used for assessment of a product or service's climate impact and expressed as carbon dioxide equivalent. Generally, carbon dioxide, methane, and nitrous oxide make up most of the greenhouse gas emissions.

Different carbon footprint calculations are not truly comparable unless the same data sources, boundary definitions, and other assumptions are used. Despite the continuous work toward uniform calculation principles, no full harmonization of the various carbon footprinting methods exists yet.

Calculator Development

The specific pilot products chosen for calculator development were selected for a couple of reasons. Firstly, volumes of publicly procured products are significant in Finland. Consequently, the associated greenhouse gas emissions are also considerable and the impact of the calculator in the procurement has the potential to be significant.

A uniform and consistent method is necessary if the CF calculators are to allow justified comparisons between products being procured. Therefore, principles from ISO standards and the PAS 2050 specification were considered, as were systems of environmental product declarations (EPDs) and product category rules. The information was used in determination of the most suitable scope (i.e., the most important stages in the life cycle) and method for use in the tools.

TABLE 1 summarizes the most important product-group-specific sources of information for the calculation tools. For the CF calculation for the paper products, the system called CEPI ten toes was selected, because it is well documented and accepted among paper-producers (CEPI, 2007). For energy-using products, we applied the unit indicators of the MEEUP method (MEEUP, 2005). The global warming potential values of materials for incontinence products are in line with previously developed values for Swan labeling (Nordic Ecolabelling, 2008). Global warming potentials of materials used in office chairs were obtained from several sources, such as Plastics Europe (2011) and MEEUP. More detailed description of the data sources, methods, and tools is provided by Mattinen & Nissinen (2011).

TABLE 1: Summary of information sources used in the calculators (see references in the text)

Product group	Method / reference for emission factors
Paper products	CEPI ten toes
Laptop computers	MEEUP unit indicators
Office chairs	Several, incl. Plastics Europe and MEEUP
Incontinence products	Swan-labeling of sanitary products
Outdoor lighting	MEEUP unit indicators

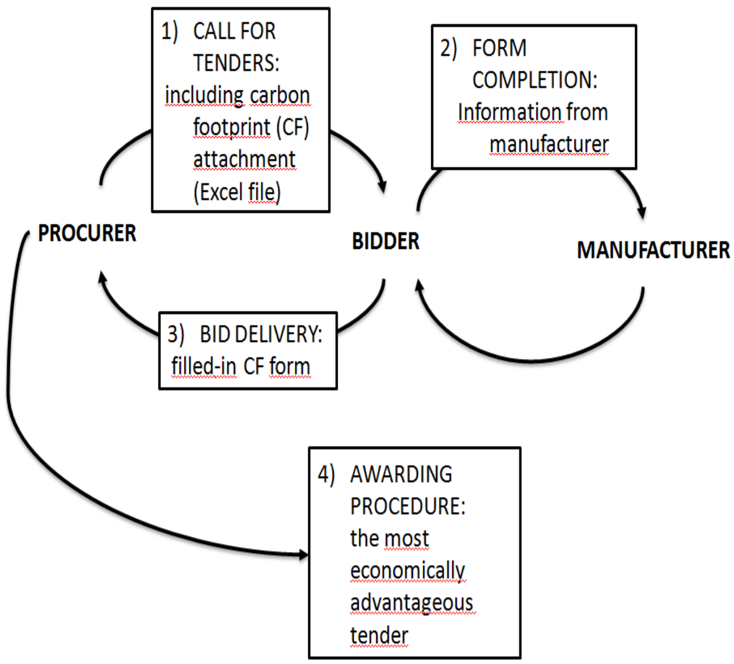

FIGURE 1: Carbon footprint calculator in the public procurement process.

Application of the Carbon Footprint Tool in a Case of Real-World Procurement

In the competitive bidding, the lowest calculated PCF value would get the best score. The other products would be awarded points relative to this lowest CF value. The simplified procurement process in which the CF calculator is used is schematically depicted in Figure 1.

The demonstration of the CF tools in a real-world procurement process was done for a procurement of desktop and laptop computers. This was carried out at the Finnish Environment Institute (SYKE) in August 2011. A restricted procedure was used on account of the framework contract managed by the central procurement unit of the Finnish Government, Hansel Ltd. Calls for tenders were sent to four potential bidders.

The calculation form developed for IT equipment was included in the call for tenders, and CF was used as an award criterion. The weight of this criterion was set at 10%. Price accounted for 60% and other technical criterion for 30%. The following widely used price formula was used for both price and carbon footprint criteria:

$$Score = Q \times L/P, \qquad (1)$$

where Q is the maximum score that can be obtained, L is the lowest price or smallest carbon footprint among all offers, and P is the price or carbon footprint value for the tender for which the score is calculated. In our case, Q was set to 60 and 10, respectively, for price and carbon footprint.

RESULTS

The Tools Developed

The carbon footprint calculation tools developed address the following products: office and tissue paper, laptop computers, office seating solutions, incontinence products, and outdoor lighting products. The main phases in the life cycle of these products are taken into account. These include but are not limited to materials' extraction and processing, final assembly of the product, and transportation from the factory gate to the customer.

Table 2 summarizes product-specific variation in carbon footprints in view of a literature survey reported upon by Mattinen & Nissinen (2011). The great range of variation is mainly a result of differences in scope definitions and calculation parameters but also caused by differences in, for example, material composition and place of manufacture.

The CF tools include a brief user guide and an MS Excel spreadsheet for calculations. The tools can be downloaded from SYKE's Web site at no charge (SYKE, 2011). They are available in both Finnish and English.

TABLE 2: Product-group-specific carbon footprint results per Mattinen and Nissinen (2011)

Product group (number of CF results reviewed)	Smallest carbon footprint [kg CO_2e]	Largest carbon footprint
Paper† (17)	96 kg CO_2/ t	1,591 kg CO_2/ t
Laptop computers (11)	54 kg CO_2e / laptop	660 kg CO_2e / laptop
Office chairs (20)	12 kg CO_2e / chair	108 kg CO_2e / chair
Incontinence products (1)	0.32 kg CO_2e ‡ / product	-

THE CASE

In the procurement demonstration case, two of the four potential bidders submitted bids. During the preparation of their bids, the bidders posed questions about the calculation of the carbon dioxide emissions along the supply chain. The answers were given in writing, and the time for submission of bids, which was originally two weeks, was extended by two weeks (Mattinen & Nissinen, 2011).

Both bidders provided information about the carbon footprint of the products they offered. However, the information received from the bidders was inadequate; e.g., crucial information about energy consumption and subsequent greenhouse gas emissions of the final assembly were missing. This led to a situation wherein the carbon footprint could not be calculated. Hence, the decision was made to award 0 points to both bidders for the CF criterion. Despite this, the two bidders did deliver a lot of meaningful information related to the carbon footprints of the products to be procured. This information will be further used to assess SYKE's organizational footprint. And it is evident that the bidders will be able to answer similar questions in later calls for tenders, since they now have time to prepare for this.

It is interesting to consider what kinds of impacts the carbon footprint could have had on the award. Theoretically, we were able to infer the missing data via expert-judgment-based values. This means that the

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† Fossil carbon dioxide emission values as reported in Paper Profiles (i.e., full life cycle not covered).

‡ Carbon footprint value based on Edana's sustainability report, available online at http://www.nappyinformationservice.co.uk/docs/SUSREPORT_LV_FINAL.pdf .

energy consumption of the final factory performing laptops' assembly was evaluated. Thus we took a theory-based approach to analyzing the ranking of the two tenders, A and B. In addition, we consider a hypothetical tender case, C. For clarity, we have assumed that the other technical requirements that account for 30% of the score were constant, so we analyze only the impact of price and carbon footprint. In other words, the maximum point values were 60 + 10 = 70, since the weight for price and carbon footprint criteria was set to 60% and 10%, respectively.

The call for tenders was for a basic and a more powerful laptop, hereinafter referred to as laptop 1 and 2, respectively. Figure 2 shows total number of points in the call for tenders as a function of price difference. The difference is relative to the lowest price; i.e., the tender with the lowest price has a difference value of 1.0 (0% above the lowest value). If, for example, a tender has a price 10% higher than the lowest price among all tenders, it has a difference value of 1.1. The various curves show the levels at which the difference in carbon footprint between tenders is constant. The uppermost curve represents the situation for the tender with the smallest carbon footprint, while the lowermost curve corresponds to a situation in which the tender has a 70% larger carbon footprint than the lowest-priced tender does. The difference increases by 10% between adjacent curves.

Tenders A and B are marked with squares and triangles, respectively (see Figure 2). We can clearly see the difference in total points between the two tenderers; tender A has the lowest price, and tender B has a price difference of 30% for laptop 2 and 70% for laptop 1. We can also see that tender B was awarded about 56 award points for laptop 2 while tender A received almost 70 points.

To illustrate further the influence of the carbon footprint criterion, we formulated a hypothetical bid for laptop 2 that has the same score of 56 points as tender B but a 70% larger carbon footprint than the smallest one (the greatest difference in price too was 70%). This is tender C, marked in Figure 2 with a closed circle. While tender C would obtain 56 award points just as tender B does, the price gap to the lowest-priced (tender A) would be only about 20%. In comparison, tender B has a 30% higher price when compared to tender A. In other words, the lowest carbon footprint value would give tender B a benefit offsetting price in this example, the difference in price between tender B and tender C being ten percentage points.

Figure 3 shows the constant levels of total number of points that can be obtained with the various combinations of price and carbon footprint values. The open circle in the bottom left-hand corner denotes the theoretical maximum of 70 points. The differences in price and carbon footprint have a similar interpretation to that in Figure 2; e.g., a difference value of 1.3 means a 30% higher value than the lowest value among all tenders. Tenders A and B for both laptop types are plotted as in Figure 2. As we can see, the point curves are almost horizontal, which indicates that the difference in carbon footprint is not as significant a criterion as price is. This can be seen with ease when one compares tenders A and B; despite the fact that tender B has the smallest carbon footprint – i.e., the difference is 1.0 – the difference between the scores is more than 10 points. It can be seen also that the difference in the carbon footprints of the tenders was less than 6%.

Additionally, the hypothetical tender is shown in Figure 3. Now the various combinations for laptop 2 can be easily compared. Tenders B and C receive almost the same number of points but with very different combinations of price and carbon footprint.

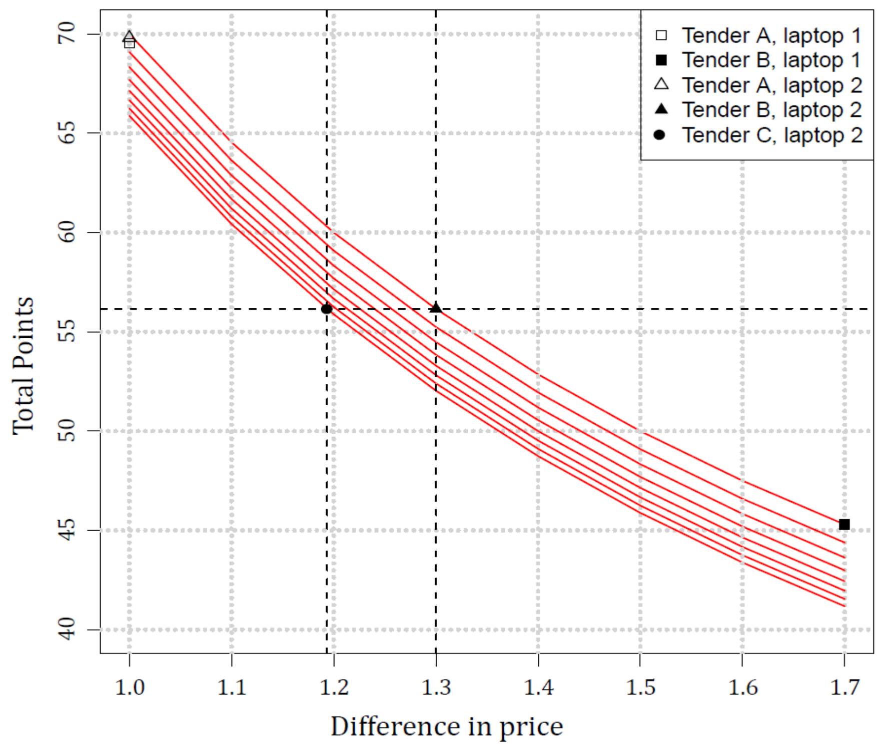

FIGURE 2: Scores of tenders as a function of price difference. The level curves for different (relative) carbon footprint values, with differences increasing by 10% between adjacent curves. See text for details.

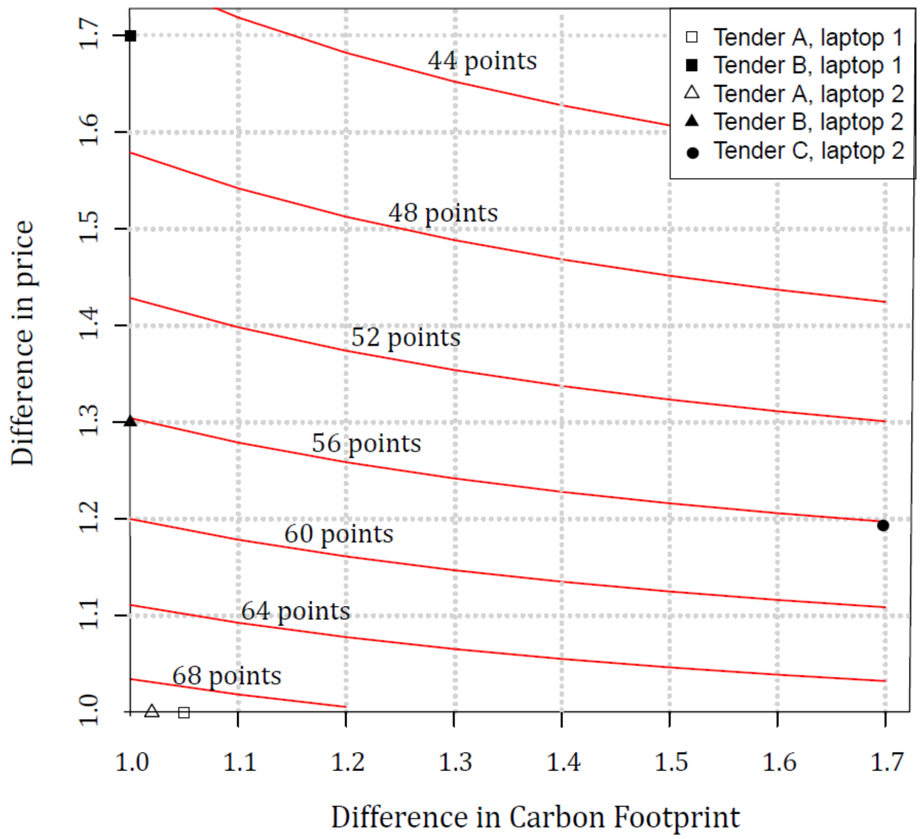

FIGURE 3: Level curves for tenders' scores in the call for tenders. Case-specific price and carbon footprint combinations are shown, as is the theoretical maximum of 70 points, denoted by an open circle at the point (1.0,1.0).

DISCUSSION

Demand by public organizations is an important factor for the development of more sustainable products and services, and for the innovative solutions that we need to mitigate climate change. Moreover, the benefits of green public procurement are not limited to environmental impacts; they can include social, health, economic, political, and other benefits. Although there are challenges in taking environmental issues into account in public procurement, there are also tools and criteria that help public parties to procure goods and services with reduced environmental impact (European Commission, 2012). One such tool is the carbon footprint calculator described in this paper.

Together with a public procurement involving a design competition for an office building (Rintala & Nissinen, 2011; Nissinen & Mattinen in this volume), this IT procurement case represents the first application of carbon footprint criteria in actual cases of public procurement. Nonetheless, it is clear that the implementation of climate strategy is seen as a challenge in public procurement processes. Psychological barriers similar to those identified by Preuss and Walker (2011) were seen during the process considered here. Our experience and the findings of Preuss and Walker point to a need to increase commitment, experience-sharing, and collaboration among public-sector organizations. Additionally there should be training and guidance in how to meet both financial and sustainability targets in specific kinds of procurements.

In the documents of calls for tenders, the carbon footprint of the offered products can be used as a technical specification or award criterion. Because knowledge about the range of CF values for products in each product group is limited (as implied in Table 2), and technical specifications would require setting of a limit value for acceptable CF, we do not recommend technical specifications yet. We propose introducing the CF as an award criterion. This allows the merits of the eligible tenders to be considered and the products for which CF information is available to be awarded points for this property, as in Equation 1. Such a formula is widely used and easy to understand.

The described carbon footprint methods will be developed further for various products and services. For instance, the potential of innovative modifications in heating and cooling equipment to decrease the greenhouse gas emissions of residential buildings will be assessed (SYKE 2012).

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