CALCULATING THE CARBON FOOTPRINT OF ECO-SCHOOLS

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ABSTRACT

MiSA – Environmental Systems Analysis has developed a model to effectively calculate the carbon footprint (CF) of individual public entities using EEIO modeling. In a project commissioned by FEE (Foundation for Environmental Education) Norway, we apply the model to individual schools in Trondheim. The aim is to identify important contributors to the CF, and to communicate results in a manner that generates curiosity and user involvement. For the latter, the development of an online interactive CF calculator has been identified as an important part of the project. Results indicate the CF of schools consists of a mix of contributions; although the public education sector is fairly building and energy intensive, a wide range of consumable categories also contribute significantly.

INTRODUCTION

A wide range of sub-national initiatives aimed at climate mitigation and other environmental issues have increasingly filled the void left by a lack of national commitments. FEE (the Foundation for Environmental Education) is one imitative that promotes sustainable development through environment-related education. Eco-Schools is one of four programs initiated by FEE. The program aims to improve sustainability through action oriented learning and is engaging eleven million students in 52 countries. The Eco-School program has been very popular in Norway, involving more than 900 kindergartens and schools. In Trondheim, the 3rd largest city in Norway, all elementary and lower secondary schools participate in the program and have been awarded the well-recognized “green flag” certification.

The 51 elementary and lower secondary schools of Trondheim is the target in this project. The aim is to assemble complete Carbon Footprints (CFs) covering all greenhouse gas (GHG) contributing elements, including the purchase of a wide range of goods and services. Further, the project aim to present the results in an interesting and educational manner to trigger user involvement and curiosity among pupils. Results will therefore be presented in an interactive online GHG calculator.

METHODS

MiSA - Environmental Systems Analysis has developed a model aimed at calculating carbon footprints (CF) (Peters, 2010) using environmentally extended input-output (EEIO) modeling (Minx et al., 2009) at the sub-national level. The model has been applied to municipalities

(Larsen & Hertwich, 2009, 2010b, 2010c), counties (Larsen & Hertwich, 2010a), and national governmental service entities (Larsen, Pettersen, Solli, & Hertwich, 2011). The strength of the model is to effectively derive carbon footprint estimates using financial accounts for the purchase of goods and services. These data are often more readily available, and in standardized formats, in comparison to more traditional bottom-up LCA calculations. However, life cycle assessment (LCA) data are included in EEIO analyses for some important contributing elements – typically energy use, waste generation and transport – in order to increase the accuracy of the calculations. Such an analysis, called hybrid-LCA (Lenzen, 2002; Suh & Nakamura, 2007), has the completeness and effectiveness of top-down EEIO modeling and detail of bottom-up LCA, hence combining the strengths of both methods into a single approach.

RESULTS

The municipal financial department of Trondheim provided an export of the financial information on the purchase of goods and services for each individual school in Trondheim. This enabled us to efficiently calculate carbon footprint results using the EEIO model outlined above. Supplementary data on the energy use, waste generation and an estimation of private transportation of pupils were then added to the calculations. Results show fairly large variations in the normalized carbon footprint, as illustrated in Figure 1.

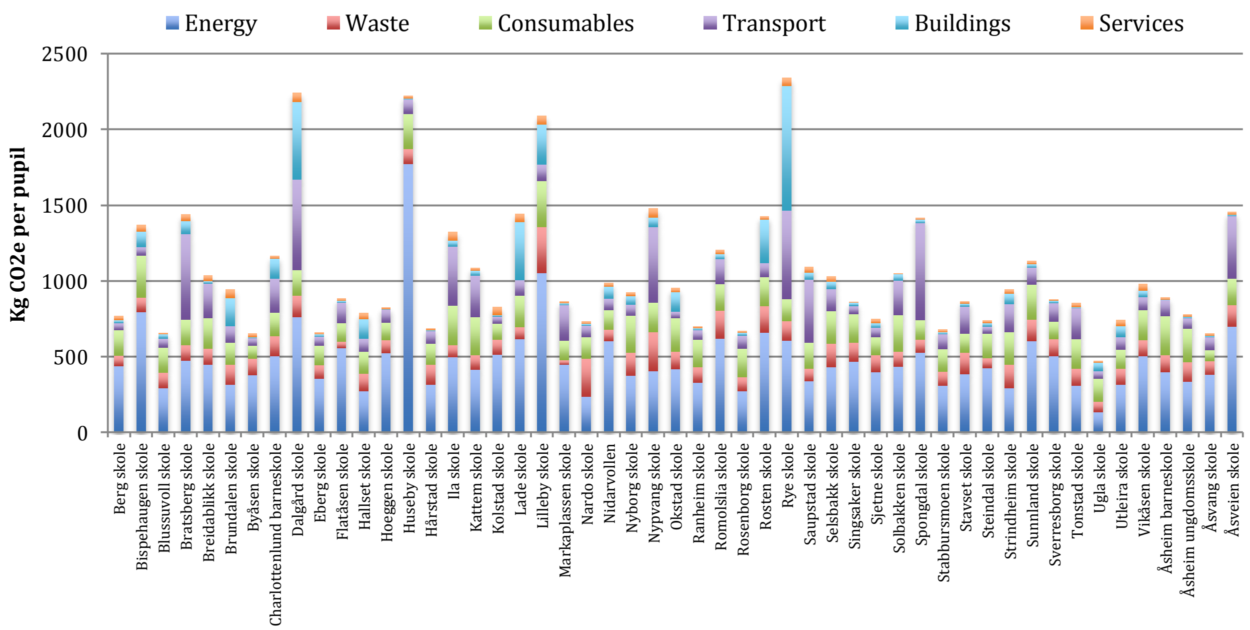

Figure 1: Normalized carbon footprint of all schools investigated. Preliminary results, further refining may be provided.

Most of the large variations and deviations have obvious causes. For example, the large contribution of energy to the carbon footprint of Huseby skole is due to a large swimming facility located at the school; renovation processes contribute to building related carbon footprints, while schools in the outskirts of Trondheim with low population density have a high contribution of transport related carbon footprint. Bratsberg and Rye schools are examples of the latter. In other cases, we find differences that more difficult to explain, and more detailed investigations into these are necessary. The overall structure of the carbon footprint is illustrated in Figure 2. Energy is identified as the highest contributor to the carbon footprint. A mix of consumables (paper, food, furniture, office machinery, etc.) is ranked second, while building-related carbon footprint is ranked third. Building-related carbon footprint typically consists of construction materials in renovation processes, but also includes daily management of buildings, such as cleaning services.

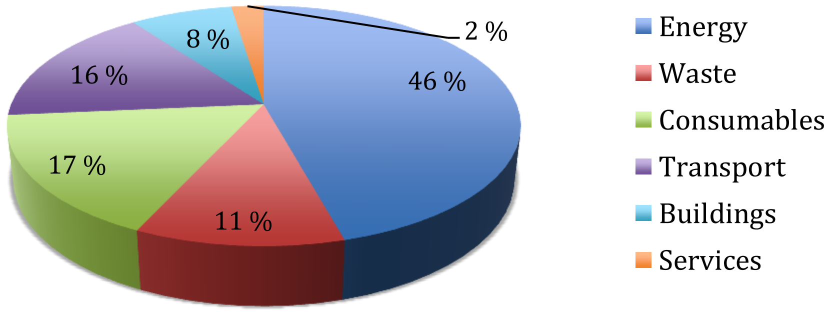

Figure 2: Overall carbon footprint structure

The large amount of data produced from the model developed has proved challenging in previous studies. Being able to communicate the results efficiently has therefore become one of the main objectives of this project. An online interactive carbon footprint calculator is under development in order to meet this need. The screenshot below shows an early version of this calculator. Note that only selected items are translated into English. The calculator will consist of two main parts: one illustrating the carbon footprint of the individual schools (left in Figure 3), and one that performs interactive calculations, showing the effect of suggested mitigation actions on the different sectors in the carbon footprint (right part of Figure 3). The effect of generating less waste, reduced car transport, and reduced/different sources of energy, are some of the available actions that are included.

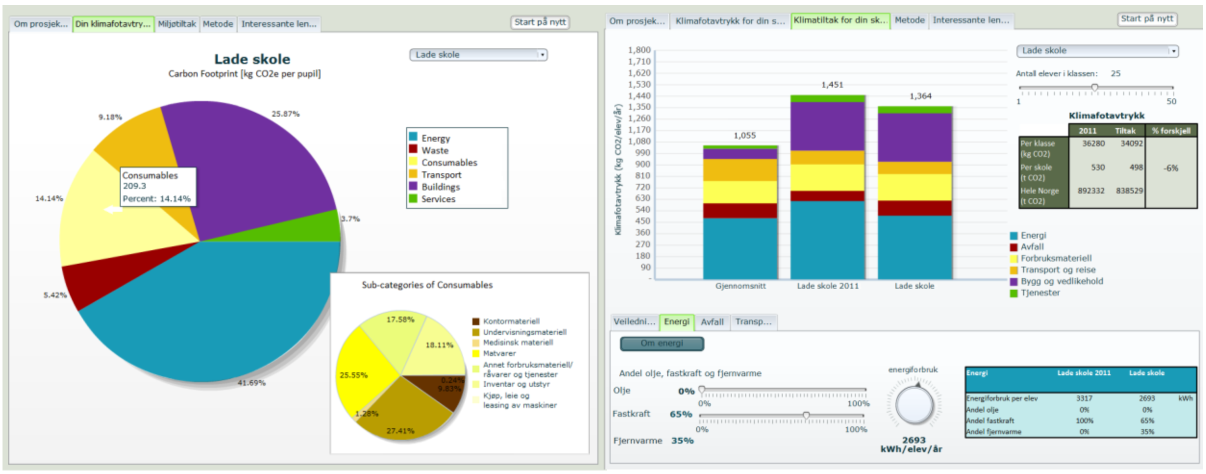

Figure 3: Screenshot of the online interactive carbon footprint calculator

DISCUSSION

Providing education is one of the main service areas of government activities. In Norway, the municipal provision of kindergarten, elementary, and lower secondary educations amounts to a total carbon footprint of 1.3 million tonnes of CO_2 equivalents. This is the largest contributing municipal services area (28 percent) and approximately two percent of the total carbon footprint of Norway, including all private and public consumption. In addition, there is obvious extra potential in directing mitigation and education strategies at pupils at such a young age that one might be able to influence their future behavior towards reducing their personal carbon footprint. Future work should aim at standardizing the GHG inventory further. The large fraction of indirect GHG emissions (scope 3, as defined by the GHG protocol (WRI & WBCSD, 2004)) embodied in e.g. consumables, building materials and waste generation clearly identify the need for the life cycle perspective. The use of EEIO modeling to cover large parts of the carbon footprint has in this project proved very useful.

CONCLUSIONS

In this project, we have calculated the carbon footprint of 51 schools in Trondheim. Results show that there is a significant variation in the normalized carbon footprint, ranging from 500 to more than 2000 kg CO_2 equivalents per pupil per year. However, in most cases, we identify reasonable probable causes of higher carbon footprints. This indicates that results should mainly be used for identifying the main target areas for the individual schools in further mitigation strategies. Overall results could further indicate potential general target areas for the entire school sector. As indicated in Figure 2, we find energy use to be a significant part of the carbon footprint of schools, so improving the energy efficiency within school buildings would be an obvious approach. Also, we see a large contribution of consumables, a category that includes paper, food, computers etc. that indicates the need for actions on green procurement.

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