Consumption-Based Carbon Accounting of Swedish and Stockholm Households

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Pre-study

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Abstract

The consumption lifestyle of today has proven to be one of the most contributing factors to the climate change our world now faces. In order to describe and analyze climate impact of Swedish private consumption this study applies a consumption-based carbon accounting model, allowing for quantification of carbon footprints of typical households in Sweden and Stockholm, by 6 household sizes and 10 income brackets, including direct and indirect greenhouse gas emissions embodied in transportation, household energy, food, goods, and services. The overall results stresses the importance of applying a consumption perspective when analyzing the connection between private consumption and climate impact, as the majority of the emissions due to Swedish final demand occurs abroad. The study also suggests that size and compositions of Swedish carbon footprints vary substantially between different types of households in terms of income, size, and location. Furthermore, the analysis shows that the quality of the results is limited by data availability and uncertainties in the methods used, creating great potential to improvements for further research.

1. Introduction

1.1 Background

The consumption society of today with constantly increasing private consumption has proven to be one of the most contributing factors of the global environmental problems our world currently faces. Our modern, demanding lifestyles with daily consumption of products and services tend to lead to a markedly change of the global climate and thus create irreversible damages on the environment (EU KOM, 2003; EU KOM 2008). In recent years, several efforts to illustrate the relationship between consumption and climate impact have been made with the aim to identify efficient strategies for reduction of greenhouse gas emissions. But still there are substantial disagreements of what such initiatives should be focusing on, and how private consumption's contribution to global warming should be measured (Wiedmann, 2009; Peters and Solli, 2010; Sangwon and Huppes, 2005).

In 2009 the City of Stockholm published their climate initiatives for 2010-2020, including a target of reducing greenhouse gas emissions, from 3,4 to 3,0 ton CO_2e/year per capita until 2015 (Stockholm Stad, 2010). This approach is based on a *production perspective*, where all emissions from different production sectors, such as agriculture, transportation, and industrial production, are summed up and allocated to the area where these sectors are physically located, regardless of who the final consumers of the produced products and services are (Peters and Solli, 2010; Wiedmann, 2009). This perspective is the basis in the international efforts of reducing greenhouse gas emissions within UN and the Kyoto protocol, as well as Sweden's 16 environmental quality objectives and the target of reducing Sweden's national amount of emissions by 4% from 1990 to 2012 (Swedish EPA, 2010). But an application of the production perspective also means that emissions from production *outside* the studied area not are taken into account, although the production is driven by final demand *inside* the studied area. This may be interpreted as the City of Stockholm's target excludes a large proportion of emissions embodied in import-intensive consumption categories such as food and goods.

In order to account for all consumption-related emissions, and thus obtain a more comprehensive picture of the relation between private consumption and environmental pressure, an approach based on a *consumption perspective* is preferable. This perspective focuses on the final consumer instead of a certain geographical area and emissions generated by production and use of products and services are allocated to the actual final users of these products and services, regardless of where in the world, or where in the production process, the emissions occur (Peters and Solli, 2010; Wiedmann, 2009). In contrast to the production perspective, this can be interpreted as the consumption perspective, ideally, does not allow any geographical system boundaries at all.

In 2011, the CoolClimate Network, a non-profit applied research consortium at the Renewable and Appropriate Energy Laboratory at University of California in Berkeley, released a first version of their consumption-based household carbon footprint calculator (Jones and Kammen, 2011). The calculator, a consumer-tool developed for households to track and benchmark their carbon emissions, is based on a hybrid model where Environmental Input-Output Analysis is used in combination with Life Cycle Analysis, so called Environmental Input-Output Life Cycle Analysis. The model allows quantification of carbon footprints of typical U.S. households for different household sizes and income brackets, including emissions embodied in transportation, household energy, food, goods, and services.

In cooperation with the CoolClimate Network, KTH Industrial Ecology performed a master thesis in 2012, where the aim was to outline the applicability of the methods used by CoolClimate Network on Swedish households (Nilsson, 2012).

1.2 Aim

The aim of this study is to apply a consumption-based carbon accounting model in order to describe, analyze, and increase the resolution of Swedish and Stockholm household carbon footprints. In order to identify strengths and weaknesses of the methods used, the results generated by the model are analyzed with respect to key factors that influence the size and composition of Swedish household carbon footprints.

2. Methodology

There are several methods and tools to analyze environmental pressures from products and services. One of the most well known and frequently used is *Life Cycle Assessment* (LCA), which has been proved as a useful tool to assess a product's environmental impact during its all life cycle phases (Finnveden and Moberg, 2005). The method has its advantage in its capability to handle a large amount of data and hence, if used correctly, include impacts on different levels of detail and character (Moberg et al., 1999). But its data-demanding design often requires complex and time-consuming data inventory processes, which means that a LCA often must be at least partly based on assumptions and theoretical approximations. (Moberg et al., 1999; Rydh et al., 2002a).

In order to avoid handling with large amount of process data different types of hybrid LCA's have been developed. One approach is to combine LCA with *Input-Output Analysis* (IOA). IOA uses monetary flows between producing sectors to describe how all these are interdependent of each other in an economic system, driven by final demand. This means that the IOA in monetary terms provides information of how much each sector needs from other sectors (*input*) to produce a dollar's worth of a product or service (*output*) (Leontief, 1986; Sangwon and Huppes 2005). An environmentally expanded IOA are conducted by integrating input-output tables with national statistics of emissions allocated to corresponding sectors, and as the transaction tables are based on national accounts, environmentally expanded IOA provides a full inventory of the emissions related to the studied area without any inherent truncation errors (Junnila, 2006).

This study is conducted with an input-output-based hybrid LCA, combining the accuracy of LCA and the comprehensiveness of IOA. The design of the model is based on the data availability, where emissions embodied in household energy and transportation are quantified using process data, and emissions embodied in food, goods, and services are quantified using IOA. This approach allow us to account for emissions from a wide range of private consumption categories and increase the resolution compared to a traditionally input-output model, and was evaluated as the most suitable design with respect to Swedish data structure and availability.

2.1 Calculations and data sources

The total carbon footprint of a household is calculated as

$$CF = \sum C_i E_i \qquad (1)$$

where *C* is the consumption in SEK and *E* is the emission factor in gCO_2e/SEK, summed over each product group, *i*. This calculation is done for a total of 32 typical households in Sweden and Stockholm, respectively divided into 6 household sizes and 10 income brackets. The consumption is represented by 100 product groups in total, divided into five major consumption categories; *Transportation*, *Housing*, *Food*, *Goods*, and *Services*.

Emissions included in this study are indirect and direct emissions of CO_2, N_2O, and CH_4. *Indirect emissions* are defined as emissions that occur during a product's whole upstream phase to the final consumer, including all stages in the production process such as extraction, manufacturing, transportation (bunkers) and distribution. *Direct emissions* are defined as emissions that occur during the whole user phase of a product, such as combustion emissions from fuels and oils (Wadeskog & Larsson (2003).

2.1.1 Consumption data

Consumption data are provided by the Swedish Household Budget Survey (HBS) at Statistics Sweden (HBS, 2012). The survey are based on interviews and expenditure records of households, which are defined as a group of persons with at least one person in the age of 0-74 year, living together with an economy shared to the extent that it cannot be meaningfully distinguished.

Data are retrieved in separate tables for households in Sweden respectively Stockholm, both including annual consumption values in SEK, classified according to the *Classification of Individual Consumption of Purpose* system (COICOP) (UNSD, 2012). In order to strengthen the quality of the data and account for annual variations in consumption, total expenditures for three years, 2007, 2008, and 2009, are summed up and divided by three, providing annual average consumption values for the whole time span. In total 6 421 households participated in the survey.

In order to take the composition of a household into account and distinguish between adults and children, whose consumption patterns can be assumed to differ significantly, a system of consumption units are applied by HBS. Since expenditures does not increase proportionately to the number of persons in a household, following scale are used to strengthen the relevance of a comparison between households of different sizes (HBS, 2012).

Table 2.1. *Consumption unit scale (HBS, 2012).*

Consumption Unit Scale	2004
- Single household	1,00
- Pair	1,51
- Additional adult	0,60
- First child (0-19 year)	0,52
- Second and following children (0-19 year)	0,42

Referring to equation (1), no actual values in SEK are used from HBS due to the fact that the total consumption value per product group in HBS does not match with the total consumption value per product group in the Swedish National Accounts (SNA) (Statistics Sweden, 2012a), which the emission factors are based on (see description in chapter 2.1.2). The reason to the deviation in total consumption values are mainly two: 1) differences in system borders between HBS and the environmental accounts, since HBS only includes households defined as stated above while the environmental accounts include all private consumption, regardless of type of accommodation (HBS, 2012; Statistics Sweden, 2002), and 2) households included by HBS tend to underestimate their expenditures (Wadeskog, 2012).

In order to account for all emissions generated by Swedish private consumption, only the consumption value proportions between different types of households (sizes and disposable income), per each product group, are used from the HBS data. In practice this means that the total consumption value for each product group in the environmental accounts are divided by the total number of households in HBS, providing default consumption values of the average Swedish household. Based on these values, consumption values for the rest of the households are scaled using the original proportions between households of different size and income provided by HBS.

2.1.2 Emissions data

Emission factors for food, goods, and services are from 2008 and based on data from SNA (Statistics Sweden, 2012a) and the Swedish Environmental Accounts (SEA) (Statistics Sweden, 2012b). All values are calculated by Statistics Sweden using environmentally expanded IOA and classified according to the COICOP system (UNSD, 2012). Since the input-output table at the SNA (Statistics Sweden, 2012a) only handling producing sectors, all values have been allocated to products by Statistics Sweden, using the proportion of each product's monetary production value within each sector. A more detailed description of this transformation can be found in Wadeskog & Larsson (2003).

Emission factors for direct and indirect emissions from household energy and direct emissions of transportation are calculated using different sources. Emissions data are retrieved from the Swedish Environmental Research Institute (IVL, 2011) and price statistics from Statistics Sweden (2012c), the Swedish District Heating Association (2012), and the Swedish Petroleum & Biofuels Institute (2012).

2.2 Imported emissions

Referring to chapter 1.1, the consumption perspective is in its ideal design free from geographical system boundaries. But a full geographical coverage is often hard to achieve due to the lack of reliable trade and input-output data for trading partners. As an effect of data unavalability input-output analyses traditionally dealing with imports in a simplified way, not accounting for differences in the technological production structure between the studied area and its trading partners. This means that emissions from imports often are quantified based on the assumption that imports are produced with the same technological production structure as domestically produced products. In order to avoid the uncertainties related to such an assumption and illustrate the global impact of Swedish domestic consumption in a more comprehensive way, this study uses a multi-regional model with a unidirectional trade assumption, including the trade between Sweden and its import partners but not the internal trade between different import partners themselves (Peters and Solli, 2010). Emissions of CO_2 embodied in imported products and services from 11 European countries (Bulgaria, Germany, Denmark, Estonia, Spain, Hungary, Italy, Netherlands, Norway, Portugal and United Kingdom) are calculated and provided by Statistics Sweden using nationally specific trade and emissions data from Eurostat. Emissions in imports from remaining countries are calculated using average carbon intensities (CO_2/BNP) for 124 countries and 13 regions, compiled by World Resources Institute based on data from IPCC/IEA and the The World Bank. (Wadeskog, 2012) Since Eurostat and World Bank lacks data of N_2O and CH_4, these emissions are added to each sector by applying the assumption that imports are produced with the same technological production structure as domestically produced products.

3. Results

This study provides carbon footprints for a total of 32 households in Sweden and Stockholm, respectively divided into 6 household sizes and 10 income brackets, including direct and indirect greenhouse gas emissions embodied in transportation, household energy, food, goods, and services. The average household in Stockholm, consisting of 2 persons and with an annual disposable income (income minus current taxes) of 400 000 SEK (HBS, 2012) has a total carbon footprint of 16,2 ton CO_2e/year, as shown in Figure 3.1.

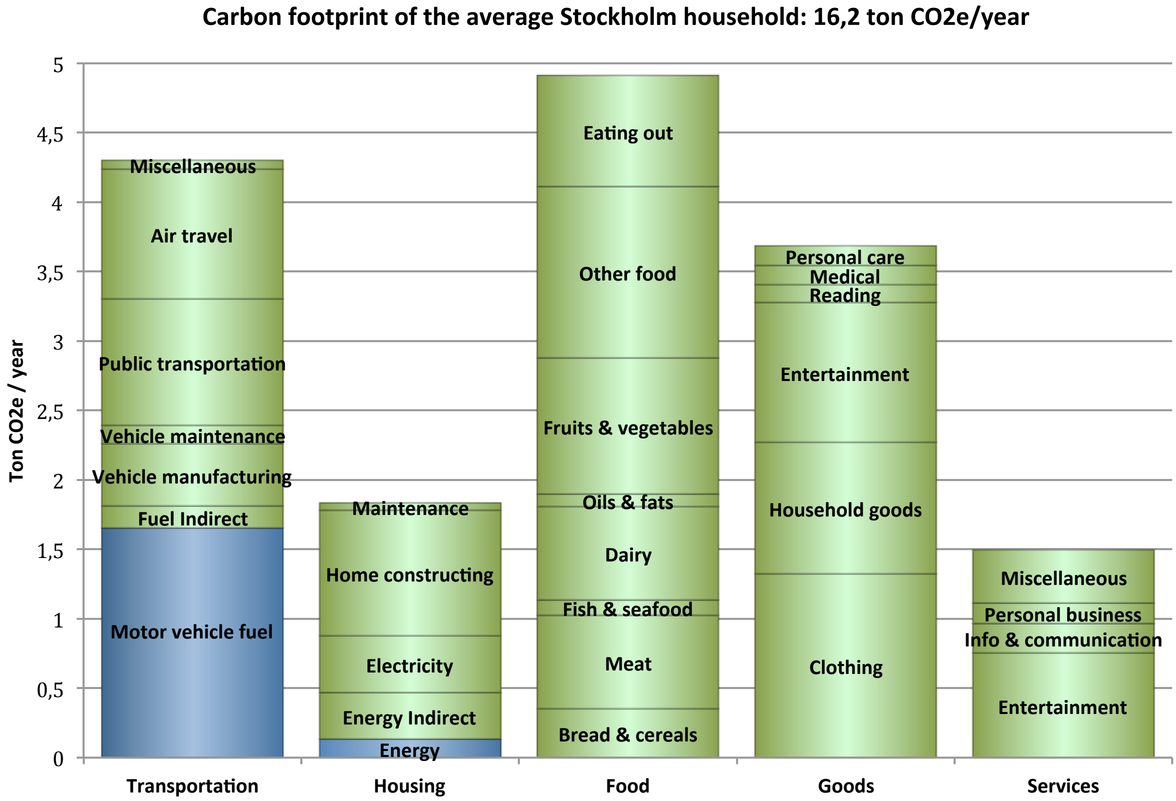

Figure 3.1. *Total carbon footprint of the average Stockholm household with 2 persons and an annual disposable income of 400 000 SEK. Blue indicates directs emissions and green indicates indirect emissions.*

In a per capita perspective Figure 3.1 corresponds to 8,2 ton CO_2e/year per average Stockholm resident. The largest contribution derives from the consumption of food, with a total of 4,9 ton CO_2e/year, followed by transportation, 4,3 ton CO_2e/year, and goods, 3,7 ton CO_2e/year. Emissions from housing and services are 1,8, respectively 1,5 ton CO_2e/year. The most single emitting product sector is motor vehicle fuel with a total of 1,8 ton CO_2e/year, with direct emissions of 1,7 ton CO_2e/year, followed by clothing, whose indirect emissions amounts for 1,3 ton CO_2e/year. Indirect emissions from the production chain are dominating and amounts for 89%, or 14,4 ton CO_2e/year, of the total carbon footprint. This means that direct emissions from transportation fuels and household energy only amounts for 11%, or 1,8 ton CO_2e/year.

In Figure 3.2 a distribution of domestic and abroad emissions for the average Stockholm household is illustrated.

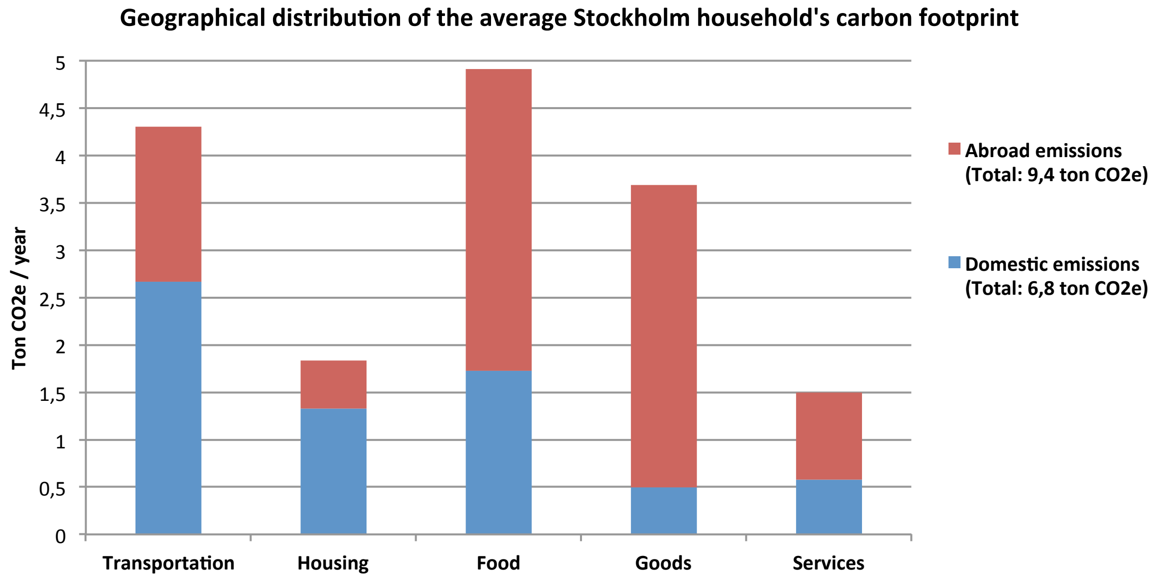

Figure 3.2. *Geographic distribution of the average Stockholm household carbon footprint.*

Figure 3.2 shows that the majority of all emissions, 58% or 9,4 ton CO_2e/year, derives from imports and consists of indirect emissions that occurs abroad. The most import-intensive consumption category is goods, where 3,2 out of 3,7 ton CO_2e/year are imported emissions, corresponding to 86% of the total carbon footprint of goods. Also a big share of the food-related emissions occurs abroad, 65% or 3,2 ton CO_2e of the total food carbon footprint of 4,9 CO_2e/year. In contrast, housing is the consumption category with the lowest share of imported emissions. Only 27%, 0,5 of 1,8 ton CO_2e/year, occurs outside Sweden.

Figure 3.3 illustrates a comparison of carbon footprint size and composition between the Swedish and Stockholm average household.

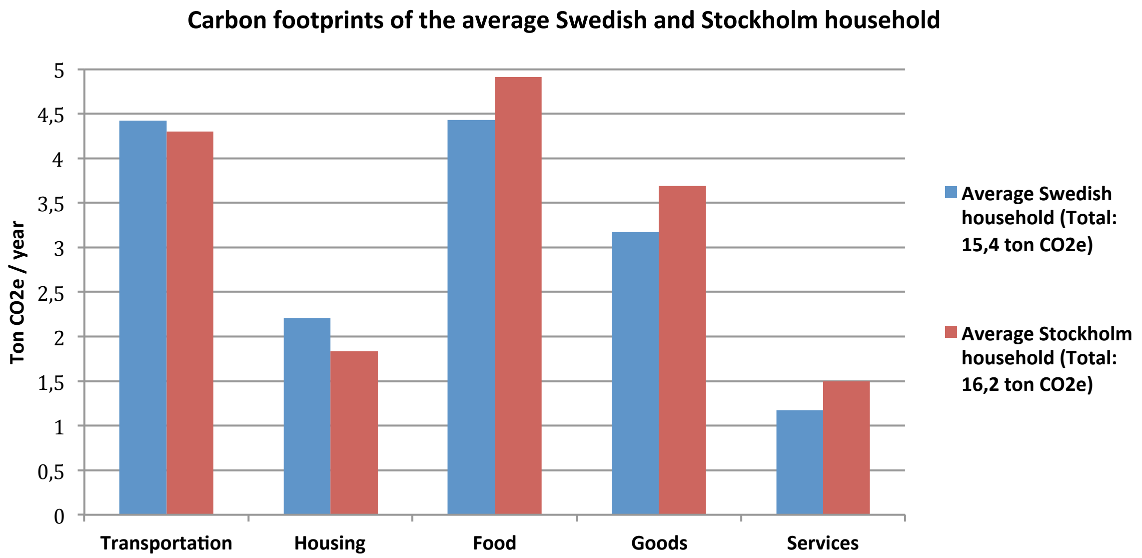

Figure 3.3. *Comparison of the average Swedish and Stockholm household carbon footprints.*

Figure 3.3 shows that the average Stockholm household has 5% larger carbon footprint in total, 16,2 ton CO_2e/year, compared to the average Swedish household of 15,4 ton CO_2e/year (7,3 ton CO_2e/year per capita), even if the Swedish household is slightly larger (2,1 persons compared to 2 persons). One reasonable explanation to this may be the difference in income, where the Stockholm household has a 14% higher annual disposable income, 400 000 SEK compared to the Swedish household's 350 000 SEK.

The average Swedish household has a larger carbon footprint in the categories of transportation and housing, 3% respectively 21%, compared to the average Stockholm household. In contrast, the average Stockholm household dominates the categories of food (11%), goods (16%), and services (27%).

The results of this study clearly show that carbon footprints vary substantially between different types of households. In Figure 3.4 carbon footprints of Swedish and Stockholm households by different size are illustrated.

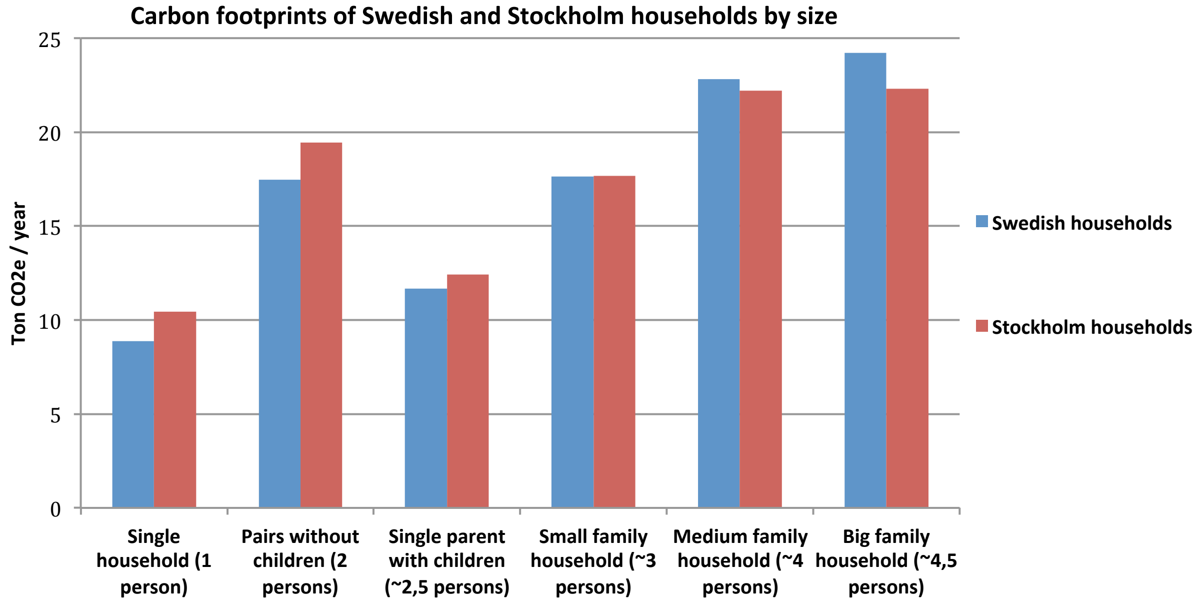

Figure 3.4. *Carbon footprints of Swedish and Stockholm households by size.*

The total span for the 6 households included in this study goes from 8,9 to 24,2 ton CO_2e/year. Notable is the Stockholm household consisting of an adult couple only, which have a larger carbon footprint, around 18,5 ton CO_2e/year, compared to a household of a single parent with children (12,0 ton CO_2e/year), and even a small family household of 3 persons (17,6 ton CO_2e/year). Figure 3.4 also shows that the internal relationship between Swedish and Stockholm household carbon footprints vary by size. Stockholm household of smaller size (1-3 persons) have a larger carbon footprint compared to the equivalent size of Swedish households, while the relationship is the opposite in households of greater size (3-5 persons).

In Figure 3.5 Swedish household carbon footprints by disposable income and consumption category are illustrated.

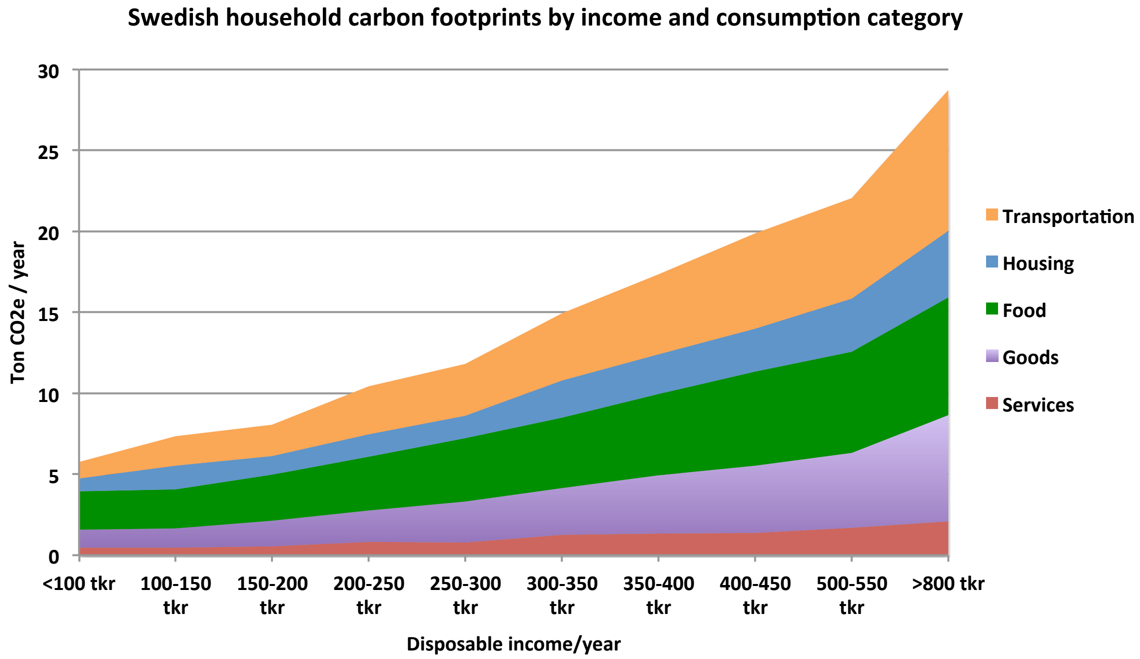

Figure 3.5. *Carbon footprints of Swedish households by disposable income and consumption category.*

In Figure 3.5 it can be noticed that all emission categories increase with income and a Swedish high-income household (>800 000 SEK/year) has a total carbon footprint of 28,7 ton CO_2e/year, more than 5 times larger compared to a low-income household (<120 000 SEK/year) of 5,7 ton CO_2e/year. The most income-influenced category is transportation, which spans from 1,0 to 8,7 ton CO_2e/year (an increase of >800%), followed by goods, from 1,1 to 6,6 ton CO_2e/year (an increase of 600%). In contrast, the category of services is least affected by income and spans from 0,5 to 2,1 ton CO_2e/year (an increase of roughly 400%).

Since the number of persons in a household may be considered as a parameter of the size of a household's carbon footprint, the use of consumption units (presented in Table 2.1) creates opportunities to analyze differences in consumption patterns between households of different size in a more relevant way.

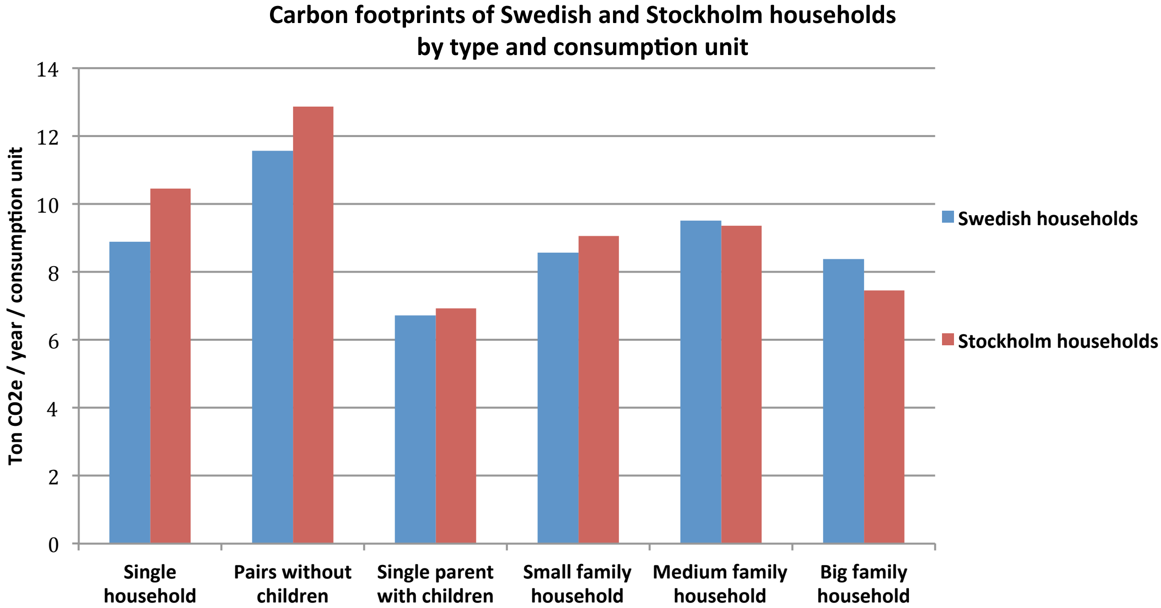

Figure 3.6. *Carbon footprints of Swedish and Stockholm households by type and consumption units.*

Figure 3.6 illustrates the carbon footprints of the same type of households as Figure 3.4 but divided by consumption units. It shows that households consisting of pairs without children have the largest carbon footprint per consumption unit in both Sweden and Stockholm, 11,6 respectively 12,9 ton CO_2e/year, followed by single households where the corresponding numbers are 8,9 and 10,4 ton CO_2e/year. In contrast, single parents with children has the smallest carbon footprint in a consumption unit perspective, with a total of 6,7 ton CO_2e/year for Swedish households and 6,9 ton CO_2e/year for Stockholm households.

4. Uncertainties

The methodology and data used in this study have great potential to improvements for further research. As always handling with Input-Output Analysis, limitation is set by the high level of aggregation of the industry classifications. The data from the Swedish Environmental Accounts (Statistics Sweden, 2012b) used in this study include 100 sectors in total, which means that large generalizations are made. Industries with large internal variations in business activity, such as transportation and food, are particularly affected by this limitation and all values provided by IOA should be considered as default values. The general significance of this problem is hard to assess but it is likely affect the accuracy of the outcomes and all household carbon footprints presented in this study should be considered as approximations.

Also the methodology of accounting for emissions abroad has potential to be further refined. The model provided by Statistics Sweden is unidirectional which not includes the internal trade between import countries of Sweden, and significant emission sources such as air travels of Swedish consumers between abroad countries are not accounted for. In addition, emissions of N_2O and CH_4 embodied in imported products are quantified with the assumption that the products generate the same amount of emissions as they were domestically produced. These limitations affect the consistency of the results but the approach was judged as the best with respect to the timeframe of this study.

Another source of uncertainty is the consumption data used, provided by the Swedish Household Budget Survey (HBS). Although the level of detail of the data can be considered as high, since it on a Swedish national level include private consumption divided into more than 600 product groups, the number of participating households can be considered as low. The data set for the whole Sweden includes 6421 households and the data set of Stockholm only 456 households. In addition to the low number of participating households (and as mentioned in chapter 2.1.1) the total consumption value per product group differs between HBS and the environmental accounts due to differences in system borders and underestimations among households. In order to account for all emissions from private consumption, the total consumption value for each product group in the environmental accounts are divided by the total number of households in HBS, providing default consumption values of the average Swedish household. Based on these values, consumption values for the rest of the households are scaled using the original proportions between households of different size and income provided by HBS. Furthermore, the consumption data tables differ in the level of detail between Sweden and Stockholm. In order to match the consumption values of Stockholm households to the emissions data from the environmental accounts certain product groups have to be disaggregated, which is done by using the proportion of the corresponding product group in the Swedish table for each type of household. Even if this method is considered as the best possible approach it may lead to some miscalculations as geographical variations in supply may affect the allocation of consumption values. For example, the data table of Stockholm only got one single product group for public transportations. As explained, the Swedish proportions between different types of public transportations such as bus, train, and subway are then used. This means that the national Swedish public transportation habits are applied on Stockholm, which not necessarily reflects the reality. The deficiencies in input consumption data decrease the reliability of the study and in order to avoid similar uncertainties in further research, consumption data for Stockholm households of a higher level of detail is desirable. According to HBS they cannot ensure the data quality for Stockholm on a more disaggregated level for the years in question due to the small amount of participating household, but planning to increase the number of households in future surveys.

5. Discussion

The overall result of this study clearly emphasizes the importance of applying a consumption-based model when analyzing the relationship of private consumption and climate impact. Referring to Figure 3.1 the total carbon footprint of the average Stockholm household is 16,2 ton CO_2e/year, corresponding to 8,1 ton CO_2e/year per person. Although direct emissions from motor vehicle fuel is the most single emitting product group with an individual footprint of 1,7 ton CO_2e/year, roughly 10 tons, more than 60% of the total carbon footprint, occurs in the consumption categories of food, goods, and services. These are also the most import-intensive categories (Figure 3.2) and approximately 70% of the emissions from food, goods, and services occur abroad, which partly explains the large share since Swedish domestic production can be considered as less carbon-intensive compared to many trading partners. In total the average Stockholm household carbon footprint consists of imported emissions to 58%, indicating that Sweden is heavily dependent of foreign production to meet domestic final demand, but also emphasizes the importance of a global transition towards a less carbon-intensive production sector.

A comparison between Stockholm and the rest of Sweden (Figure 3.3) shows that the carbon footprint of the average Stockholm household is slightly larger, 16,2 compared to 15,4 ton CO_2e/year, a difference of approximately 5%. Looking on the consumption categories individually also indicate variations in consumption patterns. The average Swedish household has a slightly larger carbon footprint in the consumption category of transportation, 4,4 ton CO_2e/year, compared to the average household in Stockholm, 4,3 ton CO_2e/year compared. A small difference corresponding to 3% and a reasonable explanation of this may be that Swedish households are more dependent of an own vehicle due to less dense cities, while residents in Stockholm uses public transportations to a larger extent for their daily transports. Looking on housing-related emissions the difference is more significantly. The average Swedish households has a 21% larger carbon footprint, 2,2 ton CO_2e/year, compared to a Stockholm household's of 1,8 ton CO_2e/year. A contributing factor to these results may stem from differences in city-density and thus price per square meter of living. In Stockholm the housing prices are relatively high compared to the rest of Sweden and Stockholm households are in general smaller in terms of area and thus need less energy and maintenance.

In contrast to the categories of transportation and housing the relationship between Stockholm and Sweden is the reverse looking on food, goods, and services. The average Stockholm household's total carbon footprint of these three categories is 10,1 ton CO_2e/year, 15% larger compared to the average Swedish household of 8,8 ton CO_2e/year. Stockholm as a big metropolitan area with a wide range of restaurants, shopping districts, and many alternatives of entertainment may be a reasonable explanation to this pattern in combination with the fact that the average Stockholm household has a higher disposable income, 400 000 SEK/year, compared to the average Swedish household, 350 000 SEK/year, a difference of approximately 14,3%. However, as the difference in total carbon footprint only is about 5% this indicates a non-linearity between income and carbon footprints and thus shows the effect of variations in consumption patterns and infrastructural conditions.

In addition to geographical differences, the results also show that carbon footprints vary substantially between different types of households. The carbon footprints of the households included in this study are illustrated in Figure 3.4, showing that carbon footprints not necessary increase with household size. Relating the Swedish households in Figure 3.4 to Figure 3.5 rather indicates disposable income as a more useful parameter, as carbon footprints steadily grow with income. This can be considered as a quite expected result as higher income enables higher consumption but looking on variations in the composition of carbon footprints across income brackets it is shown that not only the volume, but also the pattern, of consumption is affected by income. Transportation, a category with high emission factors, is the most income-influenced category while services, with generally low emission factors, is least affected by income. In order to avoid the impact of variations in household size when analyzing differences in consumption patterns the carbon footprint of each type of household in Figure 3.4 is divided by each household's corresponding number of consumptions units, using the scale presented in Table 2.1. The carbon footprints per consumption unit (Figure 3.6) reinforces that high-emitting consumption patterns primarily are connected to disposable income and not necessary household size, as the two most emitting households per consumption unit are the two smallest households in the study, pairs without children and single households.

Relating the overall outcomes of this study to the City of Stockholm's target of reducing the carbon emissions to 3 ton CO_2e/year per capita until 2015 (Stockholm Stad, 2010) clearly shows the deficiencies in applying a production perspective, as the majority of all emissions generated by private consumption are outside its scope. The approach of a production-based model may fill a function on a global level as all produced products may be assumed to be consumed somewhere, regardless of geographical borders. But applying this perspective on a local level as Stockholm, which evidently is dependent of cross-border trade to a large extent, provides a misleading picture of how private consumption by Stockholm citizens affect the environment. Although producing sectors in Stockholm have a responsibility for the emissions they generate, a target based on emissions from local production but allocated per capita may lead to misdirected focuses in future priorities and strategies, and it may therefore be defensible to questioning the relevance of the target. A consumption-based carbon accounting model would describe the environmental impact of our lifestyle in a more comprehensive way and thus provide opportunities to increase the awareness among consumers as a first step towards a more sustainable consumption.

6. Conclusions

Results

- In order to provide a comprehensive picture of the relationship between climate impact and private consumption, the overall result of this study emphasizes the importance of applying a consumption perspective, where emissions are allocated to the final consumer regardless of where they occur.
- The results of this study shows that the average Stockholm household have a carbon footprint of 16,2 ton CO_2e/year, corresponding to 8,1 ton CO_2e/year in a per-capita perspective. More than 60% of the total carbon footprint consists of emissions related to food, goods, and services. The majority, 58%, of the total household carbon footprint consists of emissions occurring abroad, which stresses the importance of a global transition towards a less carbon-intensive production sector.
- A comparison of Swedish and Stockholm households shows that the average Swedish household have a slightly smaller carbon footprint compared to the average Stockholm household, 15,4 ton CO_2e/year. In general, Swedish households have larger carbon footprints in the emissions categories of transportation and household energy compared to Stockholm households, while the relationship is the opposite in the emissions

categories of food, goods, and services. These differences in consumption patterns may be explained by differences in income, household size, market supply and other regional conditions.

- The analysis suggests that carbon footprints primarily grow with disposable income rather than household size. Looking on consumption categories, transportation is the most income-influenced consumption category while food is least affected by income.
- In order to strengthen the results and increase the resolution of the analysis there is a great potential for improvements in the methodology. There is a need to minimize the uncertainties connected to IOA, including reducing the effects of default values and the methodology of imported emissions.
- In order to achieve a more reliable and robust result there is a great need to improve the consumption data from HBS. The methodology of collecting, accounting, and presenting private consumption need to be developed in a way that better allows for this type of environmental analyses, including a greater selection of participating households and expenditures divided into product groups on a higher level of detail.

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