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Households in the environmental accounts

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Foreword

Statistics Sweden has developed physical environmental accounts since 1993. In the environmental accounts, so far, households have appeared as one of the components of final demand, thus linking it both directly and indirectly to environmental effects through what is consumed and how these goods and services are produced. This has made it possible to compare environmental pressures caused by households with pressures from other economic agents such as industries or the public sector.

This report presents possible ways to elaborate the role of households in the environmental accounts and presents results, by using household/individual surveys to identify environmental effects generated by expenditure and activity patterns of different household types. A method named decomposition is used in the report to analyse what in private consumption that is changing over time.

An international outlook regarding European Household Budget Surveys (HBS) and some European experience in the area is also presented in the report.

The report is prepared on commission from Eurostat, who supports and co-ordinates development of environmental accounts in the EU member states. The European Commission (Directorate- General for Regional Policy and Cohesion) has contributed financially to the project. The report is prepared by Maja Larsson and Anders Wadeskog with contribution from Viveka Palm.

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1 Introduction

In the recent years debate of sustainable development the role of the consumer has captured increased interest. The environmental impact of changes in life styles can be of a large importance for a shift toward a more sustainable consumption. It is therefore of interest to look into the composition of consumption and distributional aspects. In order to, for example, develop instruments to influence the behaviour of the households to be more environmental friendly more detailed information of different households is needed. In this project different ways of distributing the total emissions will be tested. That is, how to go from the macro perspective with the total emissions from the household sector, to a micro perspective where different kinds of households are identified.

The environmental accounts treat households or consumers as a component of final demand, namely private consumption. This makes it possible to calculate the direct emissions caused by the actions of consumers (they consume energy which causes emissions) as well as indirect emissions (emissions caused in the production of the goods and services consumed). Only direct emissions are automatically accounted for in the environmental accounts which amount to one third of the total emissions (of Swedish consumption) of CO2 in Sweden, as illustrated in chapter four. So there is a need for a more complete picture of emissions caused by domestic households via private consumption.

A more complete picture can be given with Input-Output Analysis (used in chapter four). Another area of interest is to try to understand how in private consumption is changing over time. One way to proceed with such an inquiry is to use structural decomposition analysis (used in chapter five). This is one way to allocate different parts of a certain change to different components that are involved.

Another expansion of the analysis is to look at the distributional aspects, i.e. how different categories of households affect the environment. This can be done by using survey data that is possible to link to the national/environmental accounts. The most likely candidate for this is the Household Budget Survey that is performed in most member states.

The distributional perspective can focus on regional, income, or other classifications that can be used to allocate environmental pressures among households in quite simple ways. By using time use surveys it is also possible to show the distribution of emissions on activities made by households, such as driving to day dare and cleaning the house.

The result presented in this report will be of interest to the EU member countries, as most have the necessary surveys, or similar surveys, and are in the process of looking more closely on the role of households and consumption. Not the least in relation to the Integrated Product Policy in the EU and sustainability indicators relating to consumption and households.

1.1 Environmental accounts

In 1993, Statistics Sweden, the National Institute of Economic Research and the Swedish Environmental Protection Agency were instructed by the Government to prepare a study covering the physical links between the economy, the environment and natural resources, the monetary reflection of these relations, and the state of the environment. The aim of the work on

environmental accounts at Statistics Sweden is to develop a system of physical accounts that are linked to the economic activities described in the national accounts. In practice this means developing a system of environmental and natural resource statistics that can be linked to the industry, product and sector categories used in the national accounts, thus forming a satellite system of accounts around the national accounts.

Environmental Accounts are based on the national accounts and the calculations of environmental variables therefore follow the classifications and definitions of the national accounts. The bulk of the work in the production of the tables for the environmental accounts is devoted to allocating environmental data over industries according to the NACE classification and at a level of disaggregation that fits with the data from the national accounts on Value Added, taxes etc.

Environmental accounts describe the connections between the environment and the economy, e.g. in natural resource extraction or the emissions of air pollutant by a given sector of society or industry. Traditionally, due to lack of data, the environmental accounts have described the events inside Sweden. Estimates of emissions to air, for example, are produced on the basis of the emissions in Sweden due to Swedish production and consumption. But Swedish consumption and production also affect the environment in other countries that produce the products we import. In the same way, part of the impact on our national environment is linked to the products Sweden exports.

Apart from the environmental pressures caused by producing goods and services, there is also environmental pressures caused by private and public consumption. In accordance with the national accounts this is classified as final demand and not part of productive activities[1].

1.1.1 Earlier work - households

Establishing a household perspective in the environmental accounts has been desirable for a long time. A report written by Statistics Sweden in 1999, “Environmental Accounts Households” (also with contribution from Eurostat), pointed at a series of inconsistencies between the consumption data in the HBS and the national accounts. The same was illustrated for the production/final demand matrices used for the input output analysis – the allocation of trade margins, imports and taxes. In this former study the results were based on data from the environmental accounts for 1993. The 1993 environmental accounts were linked to the household budget survey for 1992.

We now have the possibility to try to isolate different types of households from the total group with more detailed data covering the same period. Apart from this, the former report brought up other areas interesting to pursue. One was the possibility of including the activity pattern of household, as it comes out of the time use surveys.

[1] In the Swedish national accounts, the public sector is only included in the production system in the data that is sent to Eurostat. It is not published in Sweden.

1.2 Purpose

The purpose of this report is to illustrate some ways to use the environmental/national accounts together with household survey data to look at the environmental role of households. The bulk of this is devoted to linking Household Budget data to the results in the environmental accounts. The idea is that most member states that have developed environmental accounts can perform Input-Output Analysis and have access to more or less frequent data from Household Budget Surveys.

In addition to this an example of what can be done with the use of data from time-use surveys is provided. Many members states have done time use surveys in recent years. And although the direct links between the time use surveys and environmental/national accounts data is less direct than for Household Budget Surveys, they provide a rare opportunity to compare environmental pressures between the formal and the informal economy.

1.3 Only a step on the way….

The basic building blocks of the analysis in this report are:

Environmental accounts data – time series with emissions allocated to production and final consumption.

Input-Output Tables from the national accounts. Preferably time series in both current and T-1 prices to be able to do the structural decomposition analysis. This is not likely to be available in all member states.

Household Budget Survey data with samples big enough to facilitate interesting break downs and categorizations of households.

The techniques used in this report are fairly simple and the links between the environmental accounts and Household Budget Surveys are fairly direct, there are of course deficiencies. In Swedish Household Budget Surveys of recent years, the focus was very much on simplifications and lessening of the response burden. This meant lesser detail in many areas, one being the reporting of direct energy consumption. This is of course unfortunate when environmental pressures are the main focus.

Recent development have acknowledged the need to introduce variables and questions that address environmental issues. This promises more fruitful links between the environmental accounts and the Household Budget Surveys in the future. One of the more interesting developments is the inclusion of information on eco-labels in the purchases reported by households.

There is also a more general household economic framework around the Budget Survey where additional information could be used. This could be more information on housing and energy, public consumption by households etc.

The recent Task Force on Environmental Accounts at Eurostat highlighted the need for more analysis in general and Input-Output Analysis focusing on households as one specific area.

There is a need to publish not only the direct emissions from private consumption in the form of fuels for transport and heating on a regular basis. A more regular analysis of the distributional patterns of environmental pressures from households would also be desired.

1.4 Outline of the report

Chapter two starts with a description of the methods used in the report as well as of some of the individual surveys in Sweden, used in this report and interesting for possible future analyses.

In *chapter three* some international experience and sources are presented.

Chapter four illustrates CO2 emissions for different types of households, regions, incomes and dwelling. Three types of emissions are considered; direct, Swedish indirect and international indirect emissions.

The method of decomposition is presented in *chapter five* to further explain the development of private consumption.

Chapter six focus on activities performed by households and how the choices they make in their daily life affect their environmental impact.

Finally in *chapter seven* future studies are discussed.

2 Method and data sources

The analysis in this report is centered around the Environmental accounts and its actual or potential links to other types of statistics that is likely to be found in statistical agencies.

At the core of this is the close relationship between the environmental accounts and the national accounts by way of classification and definitions. This means that all data that can be linked to the production accounts of the national accounts can be directly or indirectly linked to data in the environmental accounts. In most cases this works through the allocation of some variable over the industries or components of final demand in the national accounts[2].

The first type of linkage is the one between the environmental and national accounts as such. Given that the data in the environmental accounts is published as direct environmental impact by actors in the economy, emissions are either allocated to production activities or to consumption activities. This means that all production related emissions are indirect emissions to consumption – it comes with purchasing a product for final consumption domestically or in another country through export from Sweden. Changes in these indirect emission between years then, at least in part, depend on changes in the volume and composition of private consumption.

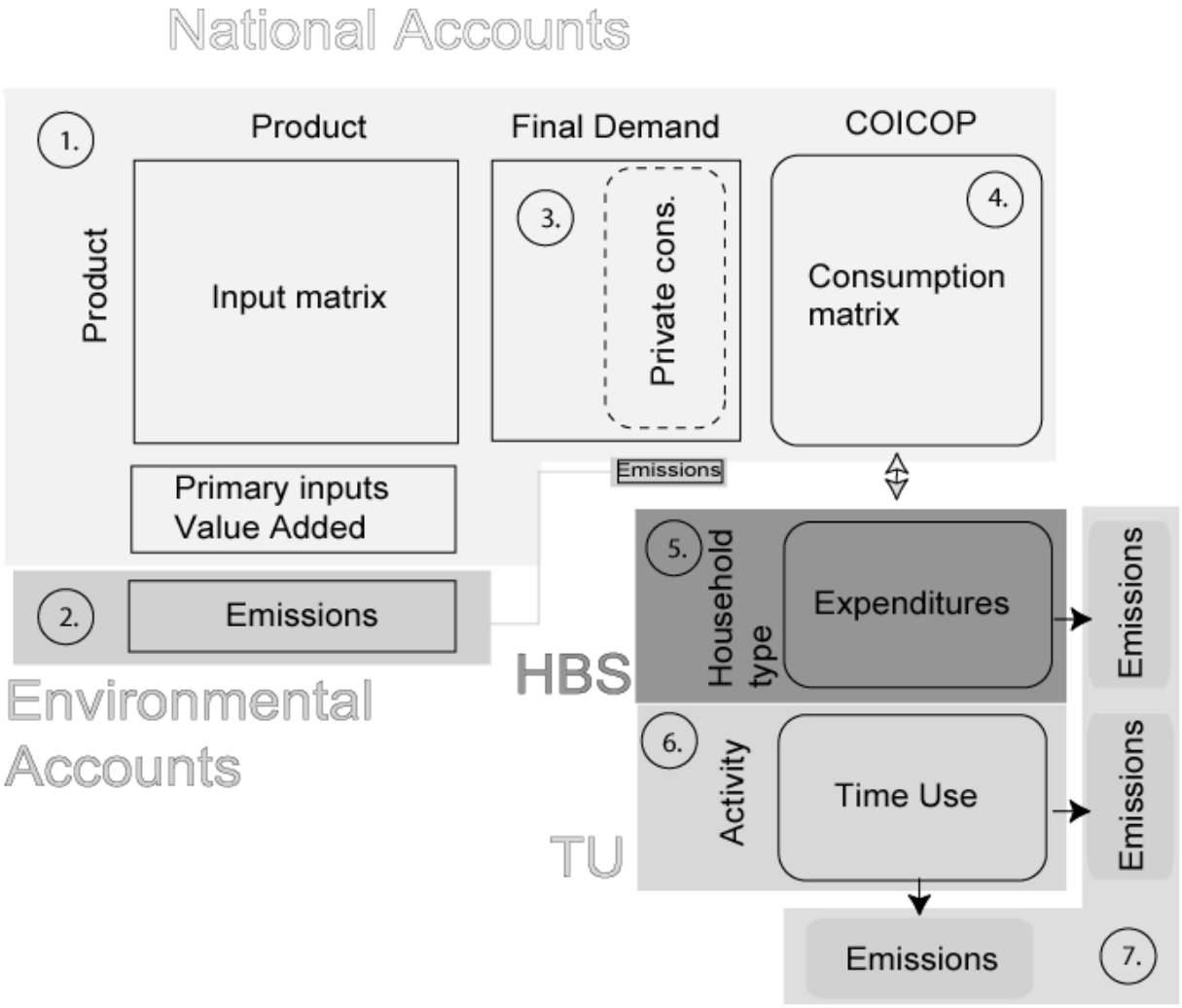
The second type of linkage is going from the macrohousehold (i.e. Private consumption in the national accounts) to individuals/households. This means, again, linking emissions to private consumption through the national and environmental accounts and then linking this to households via the household budget surveys. This makes it possible to allocate direct and indirect emissions according to all dimensions collected in the household budget survey, such as income, region, type of dwelling, number of children etc.

The other link between national-/environmental accounts data and micro data made in this report is more indirect. Linking private consumption and the associated emissions to time use in the household is done by making more or less enlightened guesses on how the purchases of products enter the different activities of the household as it is recorded in the time use surveys. Ones this allocation is done the allocation of emissions follows through the emission intensities.

The general idea can be visualized as a set of matrices that are linked in the following way:

[2] For an example of this that includes social variables see SCB 2003 (MIRINDA)

Diagram 1. Link environmental accounts, HBS and TUS



The first set of matrices (1.) comes from the National Accounts. They consist of the Use table converted to a product by product showing amounts of domestic inputs of products in making products for final demand. Adding the primary inputs and Value Added to the columns produces a production value for that product. Of the final demand matrix (3.) only Private consumption is used in this context. As all of these products are classified according to the NACE-system an additional matrix (4.) is used to convert private consumption of product according to NACE over to private consumption of products classified in COICOP.

Environmental accounts contribute the direct emissions matrices (2.) that originally calculate the emissions per industry and final demand component. The direct emissions in production is converted from industry to product in the same way as the use matrix. This is then used to produce emissions coefficients per product produced, i.e. tons of CO2 per MSEK of Agricultural products produced.

Using input-output analysis emissions (2.) is then translated into emissions per product (COICOP), Household type or household activity (7.) by using data from the Household Budget Surveys (5.) or Time Use surveys (6.) to allocate the calculated emissions per product (COICOP).

An addition to the matrices above, matrices showing imports of products are also used to calculate hypothetical emissions in other countries from Swedish private consumption. These import matrices are identical in shape to the input/Final Demand matrices above.

2.1 Input Output analysis of private consumption

2.1.1 Reallocating emissions to consumption

Input-Output (IO) models are based on the national accounts yearly tables of supply and use of products by industries and final demand.

An use table shows along the rows how much of what domestically produced products goes into production as intermediary inputs into the different industries and how much that goes to final demand. Looking at this from the industry perspective (along the columns) we get an input mix of domestically produced products that are necessary to produce the output of that industry. This is part of the production function of that industry. The rest of the production function is made up of imports, taxes and subsidies and values added (i.e. wages, profits and depreciation). Profits are seen as the residual between total revenues from sales and total costs for all inputs.

In the IO-model as presented in the picture above, a symmetric version of the use table is used – either a product by product in our case or a industry by industry table. The conversion between the product by industry table in the basic accounts to a symmetric table is done either by manually rearranging the columns and rows or by applying the allocation from the supply (or make) table that shows what industries produce the different product. In the present study, the make table is used to produce symmetric tables[3].

The core of the IO-model is the inverse (or Leontief) matrix. This matrix shows what volumes (in monetary units) that are required from all producers to supply 1 unit of final demand of a certain product. This matrix is constructed using the production recipes from the symmetric Use-table that is turned into a matrix of input coefficients (A) by taking the input matrix and relating it column wise to the production values. So the production (X) necessary to cover a certain final demand (y) can be formulated as:

$$X=(I-A)^{-1}*y$$

With I being a unit diagonal matrix and $(I-A)^{-1}$ being the inverse matrix.

If one uses the whole final demand, X is of course the original total domestic production of the products. The point of IOA is to investigate the effects on production by changes in that final demand or to look at specific components of final demand as in this case.

In this report we are only interested in private consumption, so the equation becomes:

$$X^{pc}=(I-A)^{-1}*PC$$

[3] Miller & Blair, 1985, gives an excellent presentation of input-outputanalys in different contexts

With X^{pc} being the production necessary to meet the actual private consumption (PC).

Environmental data is integrated by way of constant coefficients based on the production value of each industry. So for each industry there is information on e.g. the number of Tons of CO2 that industry generated per Million SEK of production. With a matrix of emission coefficeints – Em – emission in production caused by private consumption becomes:

$E^{PC}=Em_{*}\ (I\text{-}A)^{-1}{}_{*}PC$

This is then called the *indirect* domestic emissions, because it reallocates the part of emission in production that is caused by the private consumption part of final demand to private consumption. The remaining emissions in Swedish production is due to the other parts of final demand, i.e. public consumption, export and investments.

2.1.2 Dealing with Imports

The environmental account calculate domestic emissions that can be attributed to domestic actors in production or consumption. If one use the demand side approach to emissions that is the focus of studies of the environmental pressures from private consumption, the parts played by export and import becomes important. With the demand side perspective, a major part of domestic emissions will be caused by consumption in other countries through the production of products that are exported. Likewise, emissions from the production of products in other countries that are imported into Sweden is due to domestic consumption or for exports.

In economic terms the balance of trade (export-import) should balance over time. This is probably one reason that emissions from export and emissions from imports in other countries is assumed to balance roughly and therefore not necessary to analyze specifically. A balance between import and export in monetary terms does not necessarily mean that there is a balance in environmental terms. The structure of export and import can differ in terms of emission intensity per MSEK exported or imported. There can also be substantial differences between the emission intensities in production among the trading partners. In the case of Sweden both of these cases turned out to be true[4].

Ideally one would like to have a complete set of Environmental accounts, IO-models and trade statistics for all trading partners to calculate the emissions from imports to the domestic economy from private consumption. As this does not exist yet simpler methods are necessary to get at least rough estimates of the levels of emissions caused in other countries.

The most common approach is to use the assumption that all trading partners have an economic structure (as given in the IO-matrix) and environmental intensities that is identical to the domestic one. In other words one assumes that the domestic economy has to produce the products that are actually imported.

Based on de Haan[5] it is possible to formulate the IO-based calculation of emissions in the following way.

[4] SCB 2002

[5] de Haan 2002

$E^{PC}_{Tot}=Em^{d}_{*}(I-A-M)^{-1}_{*}(PC^{d}+PC^{m})$

With:
Imp=Matrix of imported products used as inputs in production – equivalent to the use matrix
M=Import coeffcients, i.e. Imp divided by the output vector.
PC^{d}= private consumption of domestically produced products
PC^{m}=private consumption of imported products
Em^{d}= domestic emission coefficients as above

This gives the emissions caused in other countries as

$E^{PC}_{imp}= E^{PC}_{Tot}- E^{PC}$

2.1.3 From NACE to COICOP

Given the calculations above we now have E^{PC} and E^{PC}_{imp} for private consumption. This can be worked out by NACE classified product as in the IO-system. With this it is possible to calculate the emission intensities for all products in the analysis which is what is needed for the analysis of emissions by household types. The problem is that most household based surveys of private consumption is based on the COICOP classification.

Fortunately, there is a translation system between the NACE coded products and the COICOP coded consumption by purpose. Some products appear in several purpose categories and vice versa. As it is the same total value it is easy to turn the NACE/COICOP matrix into a proportion matrix that can be used to allocate the emissions calculated for NACE products into emissions allocated over COICOP categories.

With this done it is simply a question of summing up the emissions for the COICOP categories and then relating this to the monetary value of each COICOP category to end up with emission intensities by COICOP category. The same procedure is used for emissions in other countries.

More formally:

$E^{PC(COICOP)}= \boldsymbol{i}' * (diag(E^{PC(NACE)}) * (diag(C^{NC}*\boldsymbol{i})^{-1}* C^{NC}))$

$i E^{PC(COICOP)}= diag(\boldsymbol{i}'*C^{NC})^{-1} * E^{PC(COICOP)'*}$

With

$E^{PC(COICOP)}$= emissions by COICOP category
$i E^{PC(COICOP)}$=emission intensity (Ton/MSEK) per COICOP category
$\boldsymbol{i}$=indentity vector (column)
diag=diagonal matrix with values along the diagonal and zeros otherwise
C^{NC}=matrix mapping consumption by NACE to consumption by COICOP

This can then be applied to the data from the Household Budget Surveys.

2.1.4 Decomposition of development over time

Although being a fairly recent addition to the toolbox in Environmental Accounts, decomposition analysis has been used quite a lot in energy research (Ang 1999, Hoekstra et al 2003). Apparently there are two distinct types of decomposition analysis in this field – Structural Decomposition Analysis (SDA) and Index Decomposition Analysis (IDA).

SDA uses an input–output model. But contrary to regular IOA it is less restricted by the assumptions of constant input–output coefficients as SDA uses data from two or more years to highlight, among other things, varying input–output coefficients.

An IDA usually starts from the output of the sectors to be used which means that IDA measures the direct effects only. SDA, on the other hand, uses the IOA to map output per sector from Final Demand and the indirect effects that emerge between sectors or industries and is captured by the inverse matrix.

In the present study a simple SDA was made using the so called polar decomposition forms of Dietzenbacher & Los[6]. A more general presentation of SDA using environmental accounts data can be found in de Haan (2002) or Siebel (2003), where the polar form approach of Dietzenbacher & Los is extended.

Returning to the IO-equation for emission from above with

Em = Total emission intensity per MSek output (Production value) by industry

$(I\text{-}A)^{-1}$ = Leontief inverse linking final demand to output in MSek by industry

PC/PC^{tot} = Structure of Private consumption

PC^{tot} = Sum of Private consumption

We get a slightly extended equation for calculating the level of CO_2 from private consumption:

$$CO_2^{PC} = Em^{co2} * (I\text{-}A)^{-1} * PC/PC^{tot} * PC^{tot}$$

We then use this to calculate the contributions from each of the factors that make up the equation, in the change in emissions in CO_2^{PC} between two years. This can be expressed as

$$\Delta CO_2 = \Delta Em + \Delta(I\text{-}A)^{-1} + \Delta PC/PC^{tot} + \Delta PC^{tot}$$

Where each factor contribute to the change in CO2 emissions from private consumption between the base year and the target year. Another possible formulation is to split the emission coefficients (Em) into energy intensity ΔEn^{Tot} per industry/product and structure of energy use $\Delta En/En^{Tot}$ per industry/product. This makes it possible to distinguish between effects from changes in the fule mix and from changes in the volume of energy use.

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6 Dietzenbacher & Los, 1998. A similar approach was used specifically for private consumption in Denmark in Munksgaard et al (2000)

$\Delta CO_2 = \Delta En/En^{Tot} + \Delta En^{Tot} + \Delta(I\text{-}A)^{-1} + \Delta PC/PC^{tot} + \Delta PC^{tot}$ (Emission factors that translate fuel use into emissions are constant)

There is no official IO time series for Sweden so it had to be developed within the Environmental Accounts based on the Supply and Use Tables from the national accounts in currents and T-1 prices. This meant allocating the product balances over domestic and imported products to construct yearly IO-tables in both prices. Mostly this was done with simple proportionality assumptions on the product level and deflating accordingly. The tables used covered 134 industries.

All calculations were done using the full IO- and Environmental Accounts tables (134 industries) and comparisons were made stepwise using current and T-1 prices matrices producing an accumulated change over the period, i.e. 1993-2000.

2.2 HBS-analysis

The allocation of environmental pressures over different types of households is done by using data from the Household Budget Surveys (HBS). In principle the totals in the HBS should match that of private consumption reported in the national accounts (NAPC). In practice this is seldom the case. There are several reasons for this.

According to a survey by Eurostat[7] from 1996, the discrepancy for total consumption is around 30%, of which 2/3 comes from differences in population, concepts and definitions and the rest comes from underreporting of different sorts. The differences for some countries are presented in table 1 below.

Table 1 Percentage discrepancies between HBS and national accounts data

Country	HBS data	Popul. Adj.	Def. & concept adj.	Imputed rent adj	NA estimate
Austria	77	91	91	99	100
France	64	66	77	86	100
Germany	67	77	79	87	100
Italy	63	67	74	82	100
UK	72	75	81	90	100

The differences in population stems from the fact that HBS survey private households. This means that it does not include persons living in institutions or foreign tourists. Both included in the NAPC, although the tourism factor is adjusted for in the IOA in our case. It also comes from the differences in the age groups surveyed in the HBS. In Sweden there is an age limit of 75 in the HBS while the NAPC covers consumption of all, regardless of age.

The differences in definitions and concepts are due to the different treatment of a series of expenditure types. Among these are:

[7] Eurostat, 1996

Consumption of household own production, benefits in kind, insurance, hiring/leasing, gifts and transfers, equipment and clothing needed for work, capital expenditure etc.

The major part of the difference in concepts and definitions has to do with the imputation of the rent of housing.

An adjustment of the HBS to cater for these differences, will bring the totals closer, but there will still be quite substantial discrepancies in different COCIOP categories.

Because of these differences between the levels in HBS and NAPC, the HBS is used for getting proportions between household types for the different COICOP categories. This is then used to allocate the private consumption in monetary terms over the different household types and then using the levels and composition of these consumption vectors to calculate the emissions for the household types using the emission intensities calculated above.

So for a certain type of household classification, for instance be region, this can be formulated in the following way:

$E^{HReg} = E^{PC(COICOP)\prime} (diag(\boldsymbol{i}' * C^{NC}) * (diag(HC^{Reg} * \boldsymbol{i})^{-1} * HC^{Reg}))$

With:

E^{HReg}=regional emissions
HC^{Reg}=Consumption in COICOP categories by regions
C^{NC} = Consumption in COICOP categories according to the national accounts
$E^{PC(COICOP)}$ =vector of emissions intensities (ton/MSEK) by COICOP

This was done for four different household classifications and in totals, per household, per adult equivalent and per capita, for domestic emissions and emissions in other countries. The per household etc calculations were done using the information on these included in the HBS.

An additional decomposition analysis was done to look at the effects of structure and volume respectively of consumption in the different household types. This was done in relation to the mean of all households.

In principle this meant looking at the relationship:

$CO_2 = E^{PC(COICOP)\prime} * (HC/HC^{tot} * HC^{tot})$

for different household types and decomposing for the two factors $\Delta HC/HC^{tot} + \Delta HC^{tot}$ where the Δ refers to the difference between a certain household type and the average.

2.3 TU-analysis

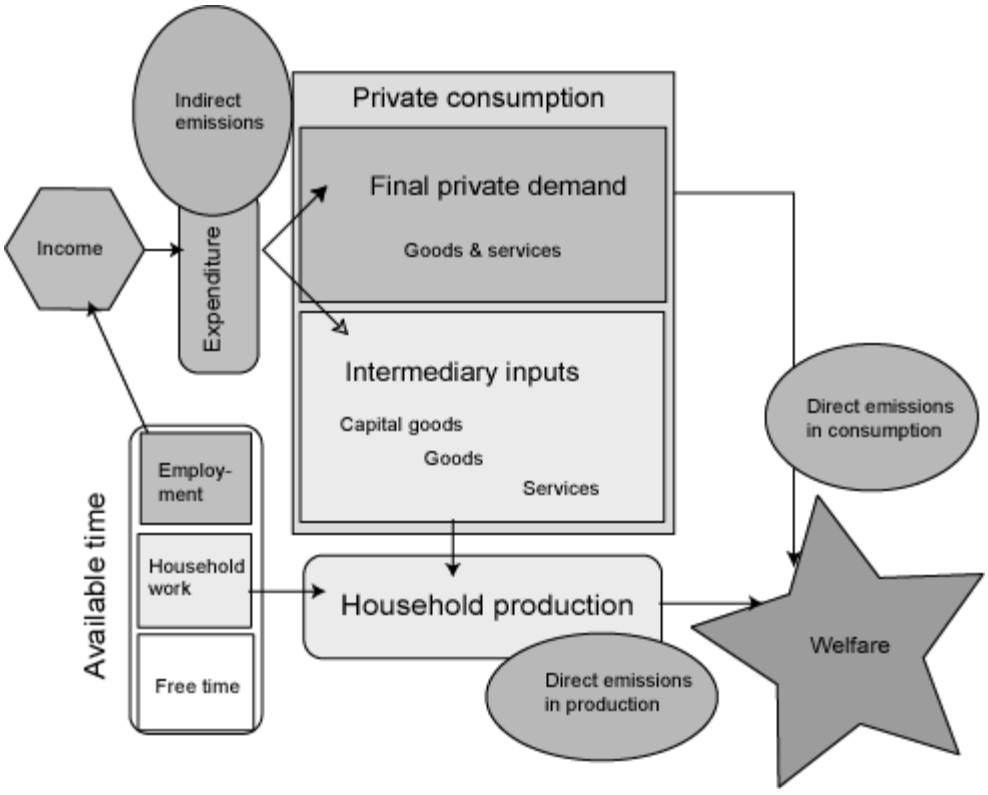
Unfortunately HBS and Time use surveys (TUS) are seldom performed for the same sample. The major reason for this is that it is seen as to demanding for the respondents and it would therefore contribute negatively to the response rates.

The general idea with linking a HBS to a TUS is that it would make it possible to analyze the environmental pressures of the household from an activity perspective. The production boundary of the National Accounts excludes a lot of productive activities that takes place in the household.

From an environmental accounts point of view this means that we only record the amount of fuels that has been purchased by households for transportation and heating. We do not link that to any production taking place in the household as we do with industries that are inside the production boundaries.

In principle we would like to link the environmental accounts to HBS and TUS to make it possible to calculate the emissions from different activities in households. Activities that have to use a certain amount of available time to make available the bundle of products that maximize the welfare of the household. This can be done through purchases in the market or by production in the household. Diagram 2 illustrate the links between household activities and emissions.

Diagram 2. Link between household activities and emissions.



In comparison with what we can achieve with the household analysis using the HBS, the only difference in environmental terms is that it would be interesting to be able to separate the emissions that arise from household production of goods from those that arise from the direct consumption. The sum of the two makes up what we call the direct emissions in the HBS based analysis.

One advantage with a measure of the emissions connected to household production activities is that it makes it theoretically possible to compare the emission intensity of household production with that of market production. Put in other terms we could compare the environmental pressures in the informal economy with those of the formal economy – per Hours worked or MSEK Value Added.

In the absence of combined surveys simplifications have to be made. In our case we make a guesstimate of the proportions expenditures on different COICOPs that is use for 16 different activities, and their accompanying transportation needs, in the household.

This is then used with the COICOP-based emission intensities to allocate both indirect and direct emissions to the different activities. Using the proportions of time used in the different categories and a simple measure of the Value Added in the household production activities it is then possible to compare the emission intensities with those of comparable production in the formal economy.

2.4 Household surveys in Sweden – used in this report

There are several different surveys in Sweden that can be used as a description of how individuals/households act and therefore have an impact on the environment. At the present a minority of them include information of environmental expenditures or activities but when linked to the private consumption in the national and environmental accounts they can illustrate how the households act and its impact on the environment, as showed in the previous method section.

It is also possible to include an environmental dimension in many surveys and the new added variable in Household Budget Survey for 2003 is an example toward this.

2.4.1 Household budget survey (HBS)

Since the 1950: s, when the modern national accounts was introduced, the HBS has been seen as the primary source for measuring private consumption[8]. Household Budget surveys have been carried out, under different names, in 1958, 1969, 1978, 1985, 1988, 1992, 1995 and 1996. The survey was revised in 1997 to come back again in 1999. It was then carried out 1999, 2000 and 2001 (this period used in this report) and took another pause in 2002, when it went through an extensive evaluation. From 2003 the HBS will continue to be a yearly survey. During the last years the classification system have been matched by the COICOP[9], which have harmonised the different systems used.

[8] Environmental accounts Households (99)

[9] Classification of Individual Consumption by Purpose

The main purpose with the HBS is to illustrate the structure of consumption in different household groups as well as give information about the total consumption of goods and services.

The main users of the HBS in Sweden are the Swedish Government, the National Board of health and welfare, The Swedish Consumer Agency, National Food administration and the National Accounts and consumer price index at Statistics Sweden.

HBS 1999-2001

The analysis in this report is based on the HBS for the years 1999-2001. The Swedish HBS was made three years in a row between 1999 and 2001[10]. Following in 2003 a analysis was made which combined the results from the last three surveys. This is similar to how Denmark and Norway make their HBS, to compensate for the smaller material and reduce the uncertainty in the approximations. The period of reference in this merger of surveys is from the second quarter 1999 to the first quarter 2002.

Expenditures and incomes from 1999 and 2000 are enumerated to the prices in 2001. The enumeration of all expenditures, except tax on motor vehicles, interest expenditures and real-estate tax, have used the most suitable of consumer price index (CPI) and a general level of CPI has been used with the enumeration of incomes.

The Swedish survey for 1999 to 2001 was a new way on publishing which gave a larger material to work with as well as less uncertainty in the approximations. The survey should in principle cover all private households in Sweden but due to possible difficulties in answering the questions for elders no individuals older than 74 years are included.

The survey in 1999 was based on a sample of 3 058 households, in 2000 the sample was 3 073 and in 2001 the amount was 3 068. The net sample was 3031, 3046 and 3027 respectively, due to emigrations, death or being part of a institution household. Every year the sample was distributed evenly on the 52 weeks. Of the net sample, 53, 52 and 50 per cent participated for the years 1999, 2000 and 2001.

In the survey the households kept an expenditure log of everything purchased over a 2-week period. Before the expenditure log they also had to answer some questions about the composition of the household. In addition to this there was an opinion poll in which background data on the household was collected. These questions concerned expenditures about the rest of the year of for example costs for holiday cottage, car fuel, insurances, vacations, furniture and clothes. Information was also collected from different registers about incomes, real-estate tax, taxable benefits and rent for a leasehold site. Information of clothing, shoes and travel in Sweden was collected on a two-month period instead of a 2-week period to be more accurate.

In the 1985, 1988 and 1992 surveys, food purchases were not collected in detail. As a substitute a separate food survey was carried out in 1989. However, in the 1995 and 1996 surveys data on food purchases was collected in detail. In the 1999-2001 survey this *booking* was once again

[10] *Hushållens utgifter 1999-2001* (2003) [Expenditures of the households, 1999-2001]

only collected on a total level which implies that non durable goods such as toilet paper and hygiene goods by mistake can have been included in these years' surveys. Besides that, meals out and bear and cider not bought at Systembolaget[11] are included.

Changes between HBS in 1999-2001 and its successors

During the break in 2002 an inspection of the HBS took place and following changes has been made. The sample has increased, from around 3000 in 2001 to 4000 households in 2003 and 2004. In previous surveys the sample was between 0-74 years. In the 2003 year survey the age limit was set to 79 years since they found it important to follow the elders consumption in a better way.

Instead of having an opinion poll asking for other expenditures (that are not caught in the expenditure log) this information is now collected through a second interview. There are also new questions in this interview, about for example costs of monthly ticket for public transportation, airplane, boat and train.

Since 2003 there is also a new complementary interview (a third interview) in the end of the expenditure log period. One purpose with this is to keep the households in the survey and therefore the first part of the interview is about the participation in the survey. Since the main purpose with this interview is to pressure the households rather than the questions itself, different actors have been able to put together the questions in the second part of the interview. These questions are called "quarter questions". Examples of questions asked during 2003 were questions of how the money lasts in the household and about environmental goods. There are thus possible to ask questions related to households and the environment to 1000 households in each quarter.

In the future the surveys will be merged every year for the two previous years (as was done in the 1999-2001 survey), as an addition to the yearly surveys.

Food purchases are yet again accounted for in detail from the 2003 survey and onwards. New for 2003 is the possibility to separate environmental/ecological goods, gifts, second hand, meals out as well as take away food (due to a different added value). It will also be possible to sort out who in the household made the purchase by sex and age. (This has only been possible for clothes and shoes in earlier HBS.)

The possibility to separate environmental/ecological goods from others is done by a new column in the HBS, asking the households to cross if the good or service was environmentally friendly. The results so far has shown that the statistics is good for food, but the quality has not been as high for other merchandise. In the future, by using the new column in the HBS it will be possible to examine what you actually chose, i.e. who chooses environmental friendly in different areas according to the total expenditure pattern, incomes, composition of the households etc.

A small project in 2003, by the unit of Economic Welfare Statistics, tried to evaluate the new environmental/ecological column introduced the same year. The results showed that it was hard

[11] State controlled liquor shop in Sweden

to find good data to compare the results with. Only a fractional part of the total amount of goods were the subject in this small project. The results showed that the percentage of environmental/ecological goods out of the total in the HBS met the percentage in comparative studies well, 2 per cent in the HBS to be compared to 1,5 to 2 per cent. Comparative information was taken from trade associations and retailers, such as for example Swedish Dairy Association and COOP. For some groups of merchandise the correspondence between HBS data and comparative information was good, for example for milk, cream, cheese and eggs. Bananas had a higher percentage in the HBS. For goods like bread and roots the result showed a lower percentage in the HBS. These results were taken into consideration for the future.

2.4.2 Time use survey (TU)

In this report the time use survey from 1990/91 has been used to show how the population distribute their time on different activities. Beside this survey there has been one more recent survey in 2000/01 that can be used in future analysis's. Both these surveys are described below.

The surveys give information of the everyday life and how people distribute their time on different activities.

TUS 1990/91

The time use survey 1990/91 was carried out after the Government bill on equality (1987/88:105). The population was all women and men between 20 and 64 years and it was carried out between September 1990 and May 1991. It was the first full-scale TU survey carried out by Statistics Sweden.

The main sample was about 4 900 individuals and of these about 3 600 individuals participated in the survey. An additional sample was made for women under 17 years with children. About the same information was collected in the TU as in the HBS. Information on income was collected from registers.

The survey consisted of an interview (visit) and two days diary keeping, with scheduled ten-minutes intervals when the investigated person writes up main and secondary activity. Where the activity was performed as well as with whom was recorded. The diary was kept for one week day and one weekend day.

A an average the households dedicated 27 hours a week to productive, unpaid work in 1990/91. The time for wage work was around 34 hours a week.

TUS 2000/01

The time use survey 2000/01 was carried out on commission from the Swedish Government. The population was all women and men between the age of 20 to 84, that is 20 years older than TUS 90/91. The survey was carried out between October 2000 to October 2001, that is 12 months compared to only 9 in 90/91. The TU in 2000/01 was harmonised with corresponding TU surveys inside and outside EU, made in later years.

The net sample was 6 218 people, divided on three different samples; individual sample (3 980), household sample (1 492) and elderly sample (746). 3 428 people completed the survey, a 59 per cent response rate.

The survey consisted of an interview (in most cases by visit) together with two days diary keeping. In the diary the participants wrote down their activities during the days, with scheduled ten-minutes intervals. It was possible to write down two parallel activities. Where the activity was performed as well as with whom was recorded. The diary was kept for one week day and one weekend day, both in a period of 2 weeks.

When time use statistics is presented on the most general level, activities in the daily life is classified in five categories:
- Work, including travel to work, pauses etc.
- Household work, including most part of the chores related to maintenance and care of family and home.
- Studies, including all types of studies.
- Personal needs, such as sleeping, eating etc.
- Leisure, including all activities not in above categories.

Differences between TUS 90/91 and TUS 00/01

In many cases the two surveys give different results since statistic significant changes has occurred. The changes can be changed behaviours and/or changed structure of population. We may not have behaved the same way in 1990 as in 2000. For example, people may not spend as much time on cleaning or cooking any longer. An example of a change in the population structure may be the lower birth of children during the 90's.

There is a difference in classification of activities between the TUS 90/91 and 00/01, but they are very small. And should not bring any problems in comparisons.

2.5 Household surveys in Sweden – possible future use

There exist several other surveys in Sweden with a focus on households and/or individuals and this section will shortly describe some of them. They can be used as a source in future analysis of the households and their habits and resulting environmental impact. *Chapter 8* will come back to these and possibilities in the future.

2.5.1 Income Distribution Survey

The Income Distribution Survey is an annual survey based on a national sample of adults, 18 years of age and over. About 15 000 households were included in the 2003 year's survey. The main purpose with the survey is to outline the disposable income among different households as well as reveal the income structure.

Information from the survey is available for the years 1975, 1978 and 1980-2001. For some years the distribution of wealth can be described. Since 2000 the sample is coordinated with the

Longitudinal Individual Data Base (LINDA). By this coordination it is possible to follow the adults and their households over the years.

In the survey data is collected for all individuals living together in the same household as the selected person. The data is collected from computer-aided telephone interviews with the selected persons and its household. The total sample has varied between around 10 000 to 20 000 individuals. At the interview, carried out in January-April every year, questions about the household and its composition are asked, together with questions about the housing and its housing expenditures. For all the individuals living in the household, questions are asked about occupation, hours of work, child care, expenditures for dental care, medicines and medical care.

Supplementing data is collected from administrative data registers and from tax return forms. The administrative data registers use information about e.g. income, taxes and transfer payments for each income year.

There are two different types of populations in the survey, housekeeping units and family units. A housekeeping unit is a household of individuals who live together in the same housing and who prepare and have meals together. According to this concept, the family unit consists of either, cohabiting with children under the age of 18, cohabiting with no children, singles with children under the age of 18, or singles with no children. Children over the age of 17 in this population are treated as adults in a separate household. Most of the presented data in this report are for housekeeping units.

The survey is used by, among others, ministries, government authorities and different analyses to shed light on the income distribution for households and individuals. The Income Distribution Survey is also the base to FACIT, Statistics Sweden's micro-simulation model. See more about FACIT below.

Variables in Income Distribution Survey

There are several questions asked in the interview that may be of interest for the allocation of consumption in the future. Especially since the survey contain information on households use and expenditures on public services. Examples of variables are;

- Costs and use of public day care
- Costs and use of dental care, dental hygienist, medicines and medical care
- Costs for medicines paid by employer
- Costs for heating
- Costs for other expenditures, such as garbage removal and sewage
- Costs for rebuilding and extensions in houses
- Costs for maintenance and repairs in houses
- Loan on the property for other consumption

Statistics Sweden's micro-simulation model FACIT

In the FACIT model it is possible to simulate budgetary and distributional effects of changes in the tax and transfer systems. It is based on HBS and the Income Distribution Survey. Variables

used in this model may be interesting for future analyses of households and their environmental impact.

2.5.2 The Swedish National Travel Survey

The Swedish National Travel Survey (NTS) has not been carried out since 2000 but there is hope to launch the survey again in 2005. This possible new NTS will hopefully be launched by Statistics Sweden. There has been an intention to combine the NTS with the Communication Survey[12] in the past but what the new NTS will look like is still unclear.

The following information is about the NTS carried out in 1994-1999. NTS gives information on the travel volume by private cars, and other means, for different types of households. The NTS collect information on travel distance, purpose of the trip, background information about the household, possession of cars, if the petrol are paid by employer etc. This makes it useful for estimating the use of energy and emissions for different types of households according to their driving pattern.

Over a period of five years NTS, The National Travel Survey examined where Swedish people are travelling. The measurement period was from April 1st 1994 and five years ahead. It covered each day over this period for 50 000 persons over the age range 6-84. The sample was drawn from the population register and computer assisted telephone interviews were used to carry out the surveys. The survey covered all trips the previous day and long distance trips over the previous months.

The aim was to provide a basis to make travelling easier, increase safety and improve the transport environment. Statistics Sweden was commissioned to carry out the survey. By the survey it was possible to study
- the number of kilometres travelled by people using different modes of transport
- different modes of transport and how these are combined and changed during different trips
- travel patterns of individuals
- reason people travel
- differences between individuals in travel patterns
- changes over longer and shorter periods
- effects of changes in terms of fees, frequency of service, routes, taxes price of petrol
- risk of accidents and injuries
- environmental effects of transport

Following variables are therefore available for the period:
- starting point and destination in form of e.g. addresses
- date and time
- length of trip
- purpose of trip
- types of transport
- accompanying children under six years of age

[12] The Communication Survey deals with the Swedes habits to send letters, talk on the phone, use of internet and similar. It has included a small part about travel.

- fellow passengers during car trip
- cost, use of tickets at reduced rates

The survey also have background data such as individual or family situation, gender, age, occupation, possession of driving licence, type of home, income, education, type of business at the work place, resources in terms of transport, number of cars in the household, type of ownership, petrol/diesel, ownership of motorbike, moped or bicycle, access to taxi service for the disabled.

3. International experiences and sources

In the first part experience from selected countries in Europe will be presented. The following part describes the access of Household Budget Surveys (HBS) in Europe. Some differences in the surveys will be discussed.

For information about a selection of European decomposition analyses based on environmental accounts data, see the Eurostat report "*Structural decomposition of environmental accounts data – the Swedish case"*, published in 2004.

3.1 Experience from selected countries

There are several countries in Europe that estimate the households' environmental effect in the environmental accounts. This section has the purpose to shortly summarize some of the methods used as well as available individual surveys in the examined countries. There are not yet many countries that allocate emissions on household types but the outlook demonstrates that many countries have the possibilities for such an allocation.

We have chosen three European countries which all show different experience in including the households in the environmental accounts. These are Denmark, Germany and the United Kingdom.

3.1.1 Denmark

There exist a long tradition for Statistics Denmark to publish input-output tables, together with multipliers for economic variables like imports, employment and energy use. The input-output calculations are used to estimate the direct and indirect water consumption and air emissions from various groups of private consumption and other types of final demand.

The Danish environmental accounts calculates energy use, water use and emissions for the households as a group. The principle is that they first calculate the direct and indirect production in the different industries due to consumers. Thereafter they calculate use of energy and emissions in the industries out from their production.

Denmark Statistics has not yet calculated emissions on for example family types on a regular basis, but they have taken part in a project where data from Danish NAMEA has been linked to the household budget survey in Denmark. This project is described below.

There are other statistical products that give information on topics in the Danish household budget survey, i.e. the national accounts and the income statistics, but the household budget survey's are more detailed and has a broader concept. For example does the budget survey include also not taxed incomes.

Research project; linking emissions to households[13]

Household consumption and family lifestyle are the subject for a Danish ongoing research project, in which the Danish environmental accounts, input-output tables and the household budget survey are used in an integrated modelling framework[14]. In a first step the households´ environmental performance is evaluated using environmental pressure indicators. In a second step, Data Envelopment Analysis (DEA) is used to construct an aggregate score in order to evaluate the relative environmental performance of the various households.

Table A *in appendix to chapter 3* shows some preliminary results from the analysis. In the project the households are grouped according to income, age and housing. The consumption of each group of households is evaluated with respect to direct and indirect contributions to eight environmental pressures: greenhouse effect, acidification, ozone depletion, photochemical oxidation, water use, total material requirement, emissions of cadmium and PAH's.

The results shows that in general, the average environmental pressures per DKK 1 000 spent are smallest for households living in urban flats and largest for households living in rural houses when it comes to pressure types which are closely linked to energy consumption (acidification, greenhouse effect and TMR). For other kinds of pressure by housing type, the pattern is much more diverse. Another tendency is that higher income families contribute less per DKK 1 000 spent. This is partly related to the fact that the share of energy consumption out of total consumption decreases with increasing income.

The information on the households´ various environmental pressures are summarised by using Data Envelopment Analysis (DEA) which was introduced by Charnes, Cooper and Rhodes (1978) as a production frontier approach tool for measuring the efficiency of a unit by computing the weighted sum of outputs divided by a weighted sum of inputs. The method can generally be used for productivity measures in cases when inputs or outputs have no observable prices or other weights attached. Instead of assigning more or less arbitrary monetary values or weights to the environmental pressures, DEA is used in the ongoing project to calculate a system of weights for each household group, which - when applied to the environmental pressures - is the best for the household group in terms of less weighted environmental pressures per DKK 1 000 of consumption. The philosophy behind this procedure of assigning weights to the environmental pressures is described as the following in Gravgaard Pedersen "*The Danish environmental accounts with examples of its use* ":

"For each household we choose exactly those weights that give the best possible result (less pressure) for the household. By doing this we present the household in the best possible light. If the household, in spite of this, turns out to have a poorer aggregated environmental performance than the other households, we can convincingly argue that there is room for improvement and that the household might be able to perform better by adopting consumption patterns from other households. The weights are chosen by solving a linear programming problem as an approximation to a non-linear programming problem, which minimises the

[13] Gravgaard Pedersen, O. "*The Danish environmental accounts with examples of its use* " Workshop for accounting frameworks in Sustainable development. Paris May 14-16 2003.

[14] The project is carried out by Institute for Local Government Studies, National Environmental Research Institute, University of Copenhagen and Statistics Denmark.

aggregated environmental pressure relative to the value of consumption. It is worthwhile noticing that this procedure only leads to an assessment of the relative environmental pressure of the households. It is by no means an absolute measure of environmental performance."

The last column in table A (*appendix to chapter 3)* presents the DEA environmental performance index based on the eight environmental pressure indices. The ranking of households is presented in categories. The Danish results shows that the elderly, middle-income households living in rural houses display the worst performance. Their performance score at 89 means that all types of environmental pressures from the household would have to be reduced to 89 per cent of its actual state if it were to obtain as little pressure as the best of the households. On the other hand, young and high-income households living in urban flats show the best performance score. Their environmental performance score at 156 per cent means that all environmental pressures could be increased by 56 per cent per DKK 1 000 consumed, and the other types of households would still not perform better.

For a full analysis one must also include the absolute levels of consumption and absolute levels of environmental pressures from the various income groups. The DEA method in combination with environmental accounts and input-output analysis give by no means any final answers to the weighting problems in relation to an assessment of the overall absolute environmental pressures by various groups, according to the OECD paper by Gravgaard Pedersen. However, he says that it might offer a starting point for a discussion of how various socio-economic groups perform relative to other groups. By using sensitivity analysis and by introducing various forms of restrictions on the weighting schemes more in-depth information on the link between the activities and the environmental pressures can most probably be revealed.

Sources of information in Denmark

Danish input-output tables comprise 130 industries and 35 categories of final demand[15]. In the most detailed tables private consumption is further allocated by 72 consumption purposes.

Accounts for energy flows show balances for supply and use of 40 types of energy. The use is allocated by 130 industries as well as by households.

Accounts for water use show use of ground water and surface water by 130 industries and households.

Accounts for Total Material Requirement (TMR) is a measure of the global resource extraction necessary to provide the material input to the Danish Economy. Direct material input is a first step.

Accounts for air emissions account for: CO2, SO2, NOx, CO, NH3, N2O, NMVOC, CH4 and various emission types. For each type of substance the accounts show the emissions by 130 industries and households.

[15] Wier M. [2004] *Evaluating sustainability of household consumption – using DEA to measure eco-efficiency and assess environmental performance.*

Denmark Statistics has not carried out a time use survey and has therefore not been able to use it to allocate the emissions on activities performed by households.

3.1.2 Germany

Germany has calculated the household's energy consumption and CO_2 emissions for heating and transport in different publications. However, they have so far only handled households as one monolith.

The Federal Statistical Office regularly compiles an input-output table of energy flows which is compatible with the monetary input-output table. Germany can therefore present direct energy consumption as well as energy consumption connected with the specific production or consumption activity[16].

When Germany distinguish between direct and indirect emissions they look at the values from the product divisions perspective (values going direct and indirect to final use products). The indirect values are always tied to intermediate consumption and because households do not deliver, by definition, intermediates, but are restricted to their role as consumers they do not cause indirect emissions. The households are responsible for direct CO2 emissions and indirect CO2 emissions that have been realized to produce final consumption goods and services.

The actual values set for energy consumption and emissions of private households are taken from the German energy balances, co-produced by several German public authorities and private research institutes.

A recent project by Federal Statistical Office in Germany has focused on emissions from transports[17]. Plans in later 2004 is to expand the traffic data in this finished project on mobility purposes and/or social groups. In the recent ended project the main interest was the integration of environmental aspects into sectorial transport policy. In this, Germany established estimations of energy consumption and emissions of transport in accordance with causing economic actors as well as with transport modes. The goal of the project was to show traffic related energy and fuel consumption as well as traffic related emissions, according to different transport modes. These were then subdivided into goods and passenger transport as well as assigned to the different economic activities and private households.

With the database that has been created from the project, it is possible to analyse in which areas emissions and energy consumption are created directly. By linking this database with the input-output tables, the indirect traffic-related burdens which arise because of intermediate consumption can be investigated, as can the original final demand which gives rise to traffic-related emissions.

[16] Schoer, Karl *Energy use of private households by purpose of final consumption*

[17] Energy consumption and air emissions caused by transport activities (transport modes / homogeneous branches and private households). EEA project supported by Eurostat.

3.1.3 United Kingdom (UK)

National Statistics in UK have looked at greenhouse gases generated directly and indirectly by households[18]. The emissions are broken down into three elements:

1) Direct and indirect emissions from energy products used for cooking, heating and lighting e.g. coal, oil, gas, electricity, etc.
2) Direct and indirect emissions from travel. Direct emissions from own vehicles and indirect emissions from the use of public transport
3) Indirect emissions from household final consumption expenditure

The emissions generated are then allocated over three household dimensions;
- by region (North West, South East, London, Wales, etc.);
- by size (one occupier, two occupiers, multiple occupiers);
- by age of the head of household (under 30, 30 to 65 and over 65)

The UK are currently considering expanding the above reporting with acid rain precursor emissions as well as waste. One problem has been that there is not enough information available, as needed for a breakdown of waste over the three categories above.

Sources of information in UK - Emissions and transports:

Data on household emissions come from the National Air Emissions Inventory (NAEI) put together by the National Environmental Technology Centre. Industry emissions come from the National Air Emissions Inventory (NAEI).

For transports the emissions also come from the NAEI. Domestic travel by mode, by region and by age is from the Department for Transport's National Travel Survey (NTS). International travel by mode, by region and by age is from the ONS International Passenger Survey (IPS).

NTS is the latest in a series of household surveys designed to provide a databank of personal travel information for Great Britain. The survey is part of a continuous survey that began in July 1988, following ad hoc surveys since the mid-1960s. The survey is designed to pick up long-term trends and is not suitable for monitoring short-term trends.

The IPS is a survey of a random sample of passengers leaving the UK by air, the channel tunnel or sea. About a quarter of a million interviews are made each year.

Sources of information in UK - Consumption and expenditure:

Households final consumption expenditure comes mainly from the Expenditure and Food Survey and is published in Consumer Trends. The supply-use information comes from the input-output team at ONS who compile the supply-use and associated tables from a variety of sources, the largest possibly being the ONS Annual Business Inquiry.

The household expenditure on the various fuel types by ages, region, etc. also come from the ONS Expenditure and Food Survey (EFT). It surveys household expenditure, food

[18] Information from Perry Francis. National Statistics, UK.

consumption and income. Some purposes are to provide information for the Retail Price Index, used for tax benefit modelling and being an important source of economic and social data for government and other research agencies.

EFT replaced the former Family Expenditure Survey (described below as it was designed in 1999) and the National Food Survey in 2001. The new survey target 7 850 households and target a minimum of 62 per cent. The survey is made up of a complete household questionnaire, an individual questionnaire for each adult over 16 about their income and a diary of all personal expenditure during two weeks. It also includes a simplified diary kept by children between 7 and 15 years.

3.2 European HBS surveys

The following information is taken from a Eurostat report published in 2003: "*Household Budget Surveys in the EU – methodology and recommendations for harmonisation - 2003*". The HBS' are among the most comprehensive household surveys and they are conducted in all member states of the Union. Through the years, their scope and content have expanded greatly giving them a particularly important role in the statistics on households. Historically the prime objective of conducting HBS in all member states was to collect information on household consumption expenditures for use in updating the weights for the consumer price index. This purpose is still an important one as the overview shows. However, over the years the variety of uses has grown and many of the surveys also give a picture of living conditions of private households in certain areas and periods of time.

Despite the common focus of the surveys on the study of patterns of consumption of private households in different population groups, the national household budget surveys symbolize a diversity of structures and designs. The HBS in the EU are sample surveys of private households carried out regularly under the responsibility of the National Statistical Offices in each of the fifteen member states. The HBS is voluntary and no EU regulation exists. There is consequently large freedom for each member state to decide the objectives, methodology, programming and resource assignment for their respective HBS.

Table 2 below illustrate the national HBS and the name of the surveys in each country.

Table 2. Names of national HBS (Eurostat, 2003)

Belgium	Enquête sur les Budgets des Ménages
Denmark	Forbrugsundersøgelsen
Germany	Einkommens- und Verbrauchsstichprobe
Greece	Family Budget Survey
Spain	Encuesta Continua de Presupuestos Familiares
France	Enquête Budgets des Familles
Ireland	Household Budget Survey
Italy	Rilevazione sui consumi delle famiglie italiane
Luxembourg	Enquête Budgets Familiaux
Netherlands	Budgetonderzoek
Austria	Konsumerhebung
Portugal	Inquérito aos orçamentos familiares
Finland	Kulutustutkimus
Sweden	Hushållens utgifter
United Kingdom	Family Expenditure Survey

There are some differences in HBS between the member states and therefore each members HBS is shortly described below. Also Norway is included.

Belgium
The aim of the survey is to collect basic data on consumption in relation to certain characteristics of households. The use is to update the weighting of goods and services for the consumption price index and to provide the data to Eurostat and the Institute of National Accounts. It is an annual survey since 1995. The net sample size in 1999 was 3 745 households. The response rate was 9,93 per cent but probably because the HBS was coupled to a Time Use Survey in 1999.

Denmark
The aim of the survey is to analyse the way in which households use their income. It is used as one of the inputs to calculate the consumer price index and to establish the national accounts. It is also used for different public and private planning purposes as well as for the comparable study of living conditions of different social groups. It became annual starting in 1994 after significant methodological changes. Before, it took place every five years. The net sample size was 2 727 in 1999. The response rate was 61.8 per cent. Great efforts have been made to minimize non-responses in the survey. To compensate for a smaller sample, Denmark has chosen to combine results from the last three surveys, enumerated to the price of the reference year. That way they receive a larger material to work with as well as less uncertainty in the approximations. From the start of the "new" survey in 1994 the data are highly comparable.

Germany
The purpose is to provide representative statistical data on the composition of private households, their socio-economic status, their income by source and expenditure by type and purpose. Since 1962/63 the survey has generally been conducted every five years. The net sample in 1998 was 62 150 usable households. A 20 per cent subsample gave detailed information on the consumption of food, beverages and tobacco. From 1999 on a continuous survey (quarterly rotating) with about 6 000 households is carried out with the intention of harmonising the "old" and "new" survey as well as supplementing the old survey for the years that it is not carried out.

Greece
The purpose of the survey is to revise the consumer price index. It is used to revise the Consumer Price Index, supplementing existing statistical data for estimating total private consumption and investigating the link between household purchases and income in kind, among others. It is carried out every five years, since 1982. The net sample in 1999 was 6 258 households. Response rate was 68 per cent. Planned changes in the survey are development of variables on food items etc.

Spain
The aims of the survey are to estimate; quarterly consumption expenditure, the change of consumption expenditure, annual consumption expenditure and quarterly and annual consumption of food and beverages measures in physical quantities. It is used to calculate the final consumption of households in the national accounts as well as weightings for the consumer price index and studies on the living conditions of Spanish households. The survey is

quarterly and the annual sample is 9 891 households with a response rate of 65 per cent. Income at the individual level has been introduced in the survey in 2002. A coming methodological change will be carried out in 2006.

France
The objective of the 94/95 HBS was to measure expenditure, consumption and resources of a sample of households. It is used for the weighting of the consumer price index, for the national accounts and for socio-economic studies. It is done irregularly, approximately every 5 years. The net sample size was 20 000 in metropolitan France and an additional 5 000 in overseas departments. The net response rate was 62 per cent.

Ireland
The HBS aims to determine the consumption expenditure structure of households in order to update the weights included in the consumer price index. The main use of the survey is for supplying the weights for the latter. Since 1994 it has a periodicity of five years and the net sample was in 99/00 7 644 households. The response rate was 55 per cent.

Italy
In Italy the aim is to measure private consumption by private households in order to satisfy their needs. It is used for establishing final consumption in the national accounts and also for the calculations of the weightings in the consumer price index. Moreover, it is used in general for social analyses including poverty studies. It is produced quarterly and annually, but only published annually. The net sample size was 20 930 households in 1999 and the response rate was 80 per cent.

Luxembourg
The aim is to obtain a weighting system for the consumer price index and to make studies on the standard of living and the consumer habits of households. Its frequency is irregular and has been carried out in 1998 and 2002. In 1998 the net sample was 2 990 households and the response rate was 50 per cent. From 2002 Luxembourg planned to start a continuous survey according to the Eurostat report in 2003.

Netherlands
The aim of the HBS is to obtain statistical information on the expenditure of different types of household in relation to the characteristics of the household, e.g. size, composition, income, socio-economic group), its accommodation and durable goods. The results have many uses, such as for example compilation of weightings to be applied to the consumer price index every five years, preparation and evaluation of socio-economic policy and improvements to the estimate of the consumption account for the household sector in the national accounts. Since 1978 the survey has been annual and the net sample size in 1999 was 1 851 households. These were 77 per cent of the original households.

The Netherlands had no HBS carried out in 2001 and 2002 due to redesigning. It started again in 2003.

Norway
The aims of the Norwegian HBS are to update the weights used in calculating the consumer price index and to study the consumption patterns in various groups of households. It has been

a continuous survey since 1974. It is yearly but to give detailed results it is necessary to cumulate over three years. The reference is the last year and the data from the previous year are adjusted using the general price index. The net sample annually is approximately 1300-1390 households.

Austria
The aim is to produce data to construct weight in the consumer price index as well as to get information for analyses of living standards and poverty. It is carried out every five years. In 1999/00 the net sample was 7 098 households which were 25 per cent of the original sample.

Portugal
The following priority objectives have been identified; to update the weights used in the consumer price index, make estimations of the consumption expenditure of private individuals for the national accounts, analyse the consumption behaviour and to construct a system of poverty indicators. Since 1989 it takes place every five years. The net sample in 2000/01 was 9 643 households. The response rate was 73 per cent.

Finland
The purpose of the HBS is to produce information on the households' or the individual's consumer behaviour, on how their incomes are created and distributed, on their debt plus the public goods and services which they receive in the form of welfare services (for example education and health) and on ownership on durables. It has been used traditionally to provide information for the revision of weights in the consumer price index with more purposes in later years. The net sample was 4 359 households in 1998. The response rate in 1998 was 63 per cent.

United Kingdom
The main aim is to provide the weight for the retail price index (the UK consumer price index). The results also contribute to the estimates of households' final consumption for the national accounts. Besides the use for the price index and national accounts, the survey is used to model tax and social security benefit systems and for close by studies and research. It has been annual since 1957. The net sample in 99/00 was 7 100 and the response rate that year was 63 per cent.

4. Distribution of CO2 emissions

In this chapter CO2 emissions for different types of households will be illustrated, based on the grouping in the Household Budget Survey (HBS). This is possible by linking information from the environmental accounts with the HBS and that way distribute the emissions over different types of households. See more about the method in *chapter 2*. Different types of households have different consumption patterns and therefore different environmental impact, by their total emissions.

The HBS (99-01) is here used as a key to allocate the macro data where the respective years private consumption according to purpose (from the national accounts) is allocated onto different types of households as in the HBS. More can be read about the HBS in *section 2.4.1*. The emissions can be allocated after all the grounds of selection in the Household Budget Survey (HBS) and in this project we use it to distribute the emissions on the Swedish counties, household types (i.e. single women without children, single men with children), type of dwelling (i.e. rental, house) and income deciles (from 1 to 10). We also show the difference in results depending on if the emissions are illustrated in total emissions or per household, per expenditure or per adult equivalent.

The following chapter (five) will further explain the development of the private consumption during the years by the method of decomposition since the environmental impact from households depend on, among other, the volume of the consumption as well as on how it is compounded. Chapter five also take the analyse further by including the methods to find out the impact from the households activities patterns.

4.1 Three types of emissions

If looking to the macro perspective of household emissions, there are three components to consider;

1) **Direct emissions** in private consumption from fuel and heating
2) **Swedish indirect emissions** from the production of goods and services in the Swedish private consumption
3) **International indirect emissions** from the production of goods and services consumed in Swedish households, before being imported.

All three types of emissions above sum up to the total emissions from private consumption in Sweden.

Direct emissions caused by the action of consumers can basically be said to be the consumption (use) of energy, i.e. fuel for private cars and heating in private homes.

However, private consumption is responsible for more than just the emissions from the fuels that are purchased to drive the car and heat their homes. All products that are purchased have an environmental impact when produced. This is called the indirect emissions from private consumption. The indirect emissions are an essential part of the total emissions from households as seen in diagram 3 below.

Indirect emissions can either be domestic or occur in other countries due to the products that are imported into the domestic economy (regarding other countries, see below). Indirect domestic emissions from private consumption are a subset of the emissions that is recorded in the environmental accounts. A part of what all industries produce goes to private consumption, the rest goes to public consumption, export and investments.

In order to calculate the amount of emissions in Swedish production that can be attributed to private consumption, Input-Output analysis (IOA) is used. One of the purposes of IOA is to calculate the amount of domestic production that is needed to satisfy a certain final demand, in this case private consumption. Once the amount of production in the different industries is determined, the amount of emissions from all industries can be calculated with the data from the environmental accounts.

It is necessary to cover also the emissions used to produce the Swedish imports for a full analysis of the consumption. For this we need information about the production relations in the countries we import goods from. Emissions in other countries that is caused by Swedish private consumption goes via trade from all trading partners to Sweden.

The same reasoning as above, where IOA is used to calculate the amount of emissions that can be attributed to private consumption, applies to emissions in other countries. This can be done if one applies the assumption that all economies are identical in terms of production structure and energy intensity. This is of course not true, but its one (and perhaps the only) way to get an estimate of the proportion of emissions caused outside the domestic economy[19].

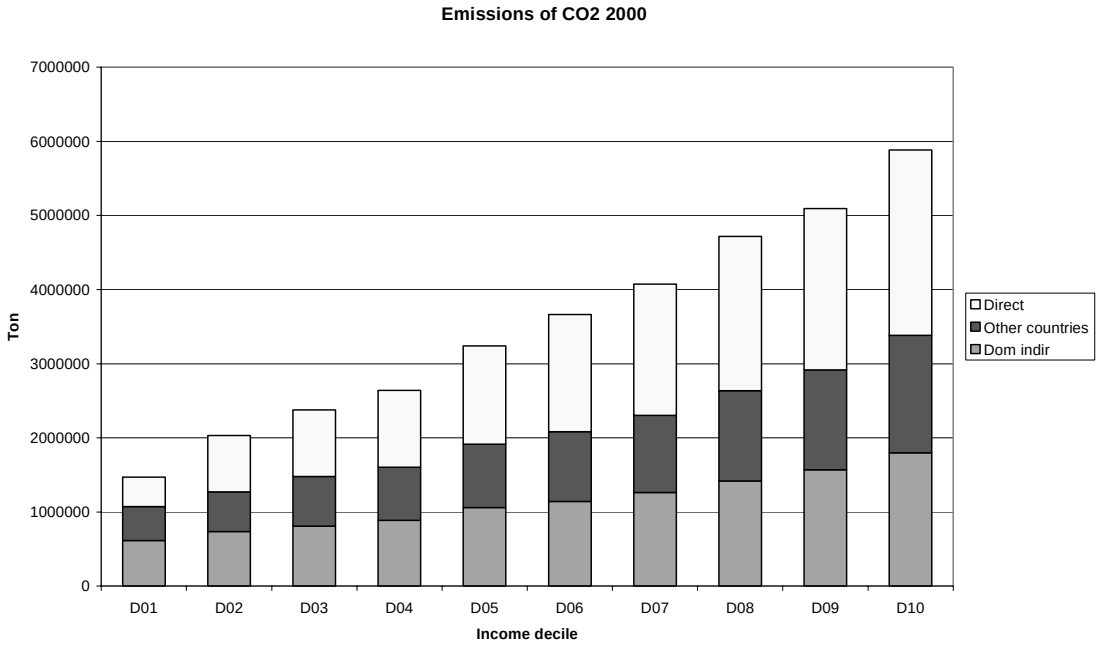
Looking at environmental pressure from private consumption, including all three types of emissions is necessary. Although the trend over time is roughly the same, the levels are substantially different and the augmented series poses interesting questions about an international division not only of labour, but also of emissions. And those are not the emission permits that have been the focus of the debate over the last few years.

4.1.1 Trend in total CO2 emissions

In diagram 3 the total emission of CO2, caused by private consumption, is presented for 2000, per income deciles. The three components make up roughly one third each.

[19] Other methods, besides assuming that all economies are identical, were analysed in an environmental accounts report published in 2002, "*Environmental impact of Swedish trade*". One method in this project assumed that all goods have emission intensities equal to the national average for each country. However, this information is not available for the whole time series (1993-2000) at this time.

Diagram 3. The total emissions of CO2 in 2000



The households in diagram 3 are classified according to income deciles which is a common way of categorize households. The ten deciles are grouped according to disposable income, where the first decile has the lowest income and the tenth decile has the highest. The total emissions caused by the different households in income deciles 1 to 10 is here directly related to its respective share of total expenditures.

The diagram illustrates that rich households emit more than poorer. The CO2 emissions increase with increasing disposable income for all three kinds of emissions. The poorest tenth only emit 25 % of what the richest tenth emit.

The share of the indirect emissions tend to decrease and the direct emissions increase with rising disposable income. For households in decile 1 indirect emissions answer for 42 per cent of the total emissions in the decile and for decile 10 about 31 per cent. The share of direct emissions in decile 1 is 27 per cent and 43 per cent in decile 10. The results indicate that the poor have a larger impact through their consumption than by their direct emissions. The richer, in the tenth decile, have a larger impact by their direct emissions, for example heating their houses and driving cars.

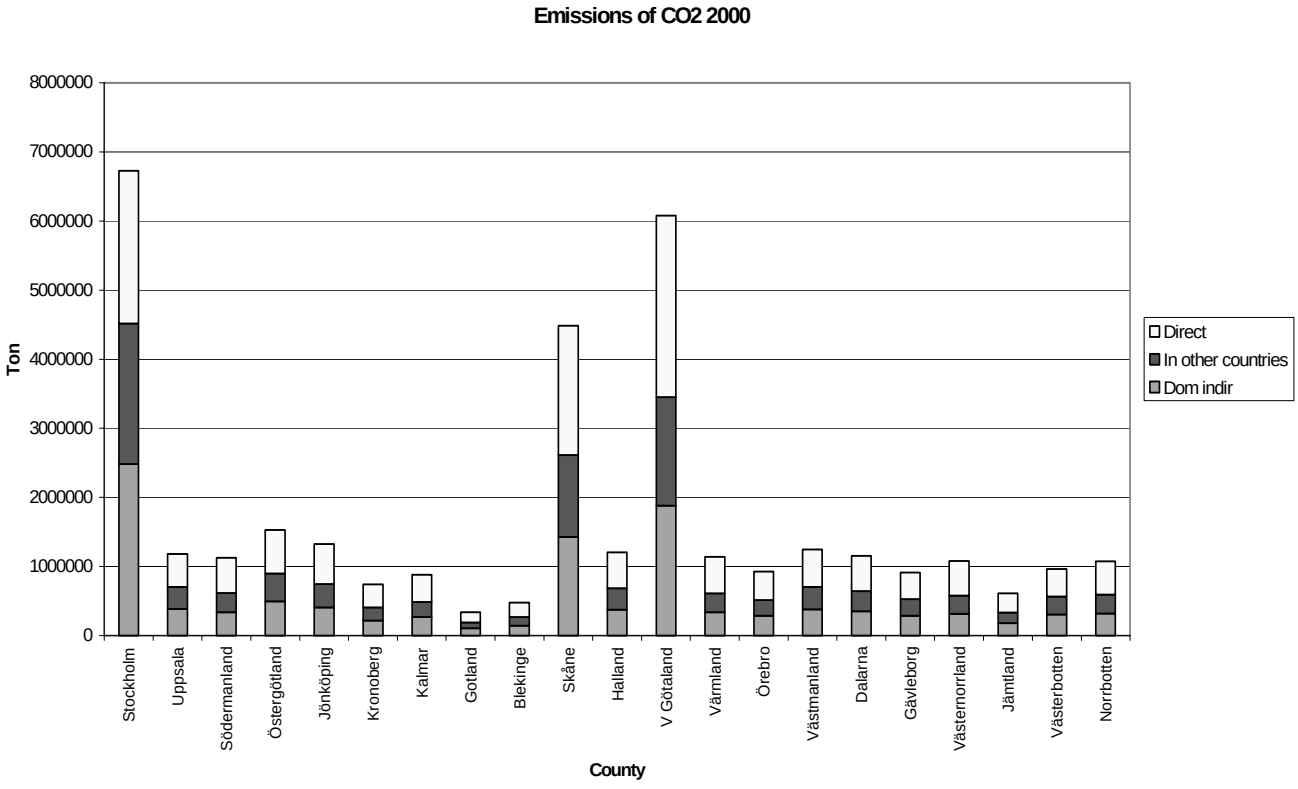
The share of emissions to other countries from the Swedish import remain between 26 and 31 per cent in the different deciles. There is no major difference between the different groups according to disposable income.

4.2 Regional distribution

In the HBS there is a regional grouping which makes it possible to distribute the CO2 emissions on the Swedish counties.

Diagram 4 demonstrates the total CO2 emissions allocated on the 21 counties in Sweden. A county is a large area consisting of several municipalities. It clearly points out three counties with the highest score of total emissions.

Diagram 4. Total emissions of CO2 in 2000 allocated on counties in Sweden



Stockholm, Skåne and Västra Götaland, which include the three largest cities in Sweden, Stockholm, Göteborg and Malmö, naturally emit the most in total terms. Looking at the totals may therefore not be very interesting for the purpose of this paper and the emissions will therefore be distributed on other that the totals. Further in the report per household, per million SEK expenditure and per adult equivalent will be used. To begin with, the total emissions must be placed in relation to the number of households in each county.

Before looking at the total CO2 emissions per household in the next diagram, diagram 4 can be further analysed by the shares of the direct, indirect and international emissions in each county. By looking at shares of total CO2 emissions in each county, Stockholm has the largest share of domestic indirect emissions, that is from consumption, 37 per cent. All other counties have a much lower share, of between 29 to 32 per cent, for the indirect emissions.

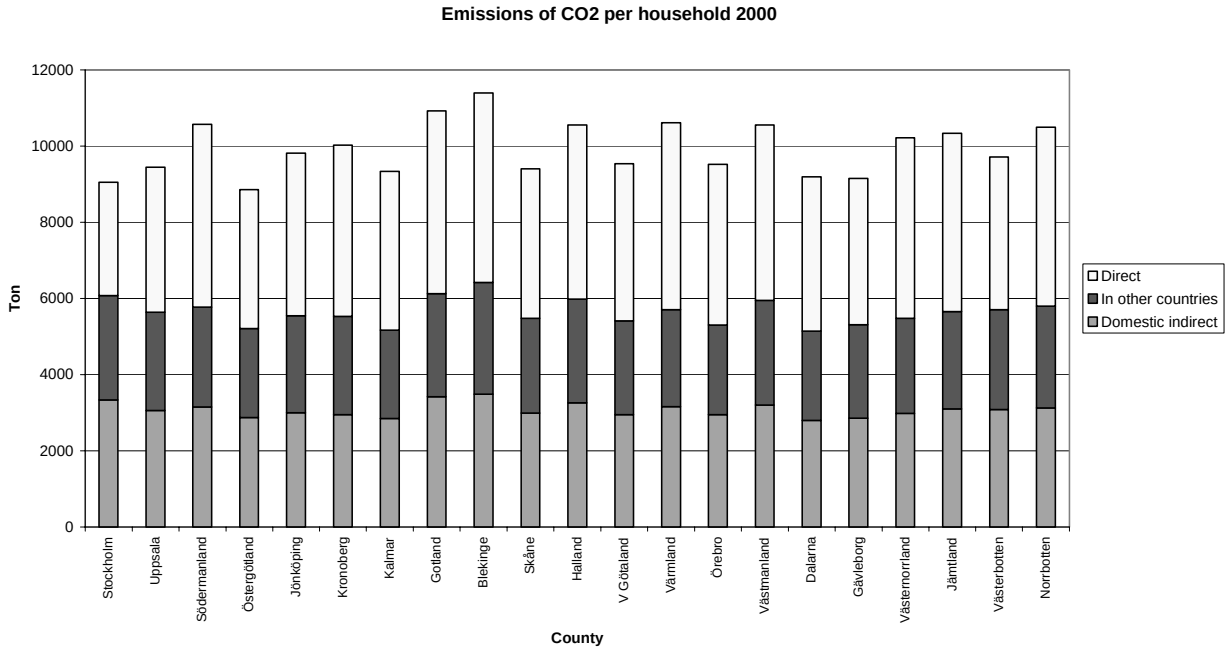
On the other side, Stockholm has the lowest share of direct emission, for heating and driving, only 33 per cent of its total emissions. This can be compared to around 43 per cent in Skåne and Västra Götaland. Most of the counties have a share of around 45 per cent of direct emissions per total emissions in each county.

4.2.1 Per household

If the total emissions from Diagram 4 are instead translated to CO2 emissions per household it shows a different result. The share per county of direct, indirect and international emissions stays the same in both diagrams, but the three areas with the most inhabitants are no longer the areas who emit the most.

Diagram 5 has Stockholm positioning among the counties with the least total emissions per household.

Diagram 5. CO2 emissions per households



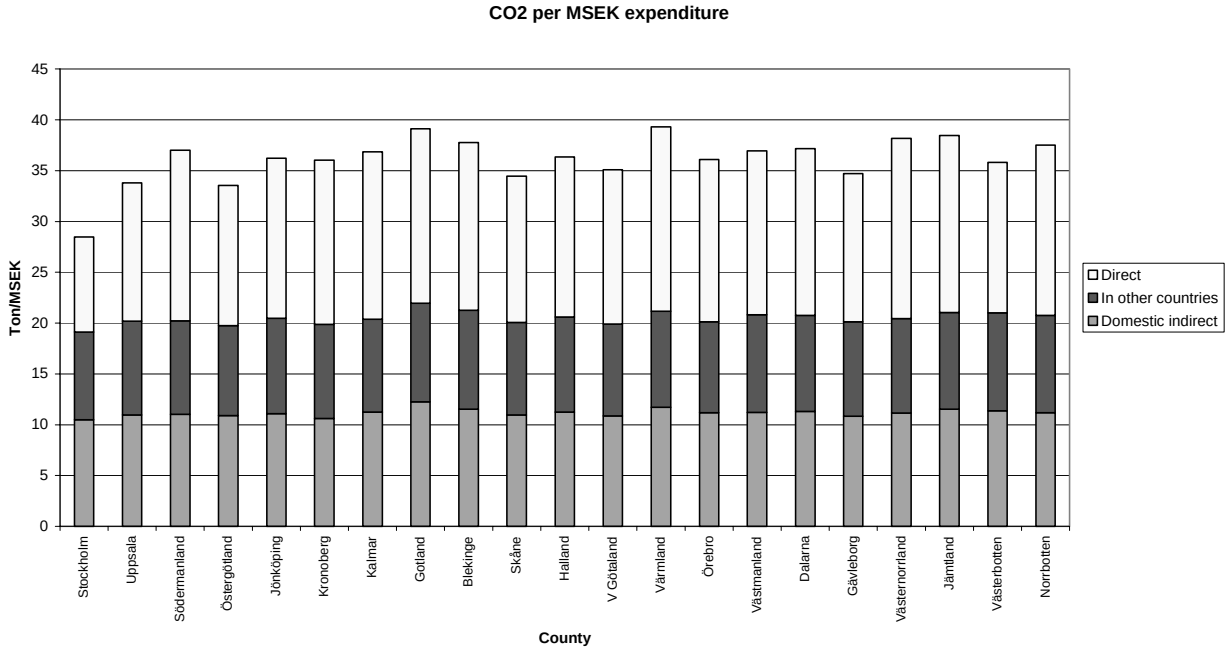
When using emissions per household, households with many members result in larger emissions. In cities with many single households, which is common in large cities like Stockholm, the total emissions per household is among the smallest.

One way to see the result is to assume that each group has an emission quota which shall stand in relation to its share of the total household population. If using per household to distribute the emission, counties with a large share of singles have a unused quota while cohab households has taken a too large share.

As an opposite from emissions per household we could have used per capita, where all members in the household count as one person. Using per capita would instead lead to the smallest emissions for households with more people, i.e. many children in the household.

However, in diagram 5 it was shown that the consumption patterns of individuals in the county that account for the major part of the *total* emissions is more environmental friendly than of the individuals in counties that account for a lesser part of the total emissions. The following diagram 6 illustrates this even more clearly when translating the total emissions to emissions of CO2 per million SEK expenditure. The result is shown as ton per million SEK.

Diagram 6. CO2 emissions per million SEK expenditure, 2000



Stockholm has 28,5 ton CO2 per million SEK expenditure which is the lowest of all counties. This is due to that the total expenditures are the largest in Stockholm. The small county as Gotland is placed among the counties with the most emissions per million SEK expenditure.

But if we want to find out which types of households account for the most emissions, and depending on the composition of the household, we need a better translator than per households or per million SEK expenditure. A child does not contribute as much to the emissions as an adult and more people living in the same household is more energy efficient.

4.2.2 Per adult equivalent

The adult equivalents in the HBS is a weight system that consider the composition of a household. Another term for adult equivalent is *consumption unit factor*, which means the same thing but may indicate more clearly that it is the consumption that is in focus. It is a weight system that considers how the household is composed. All expenditures do not increase proportionally with the number of individuals in a household. If the expenditure is divided with the weight of consumption, as seen in the table below, more fair comparisons of the total expenditures can be made. The adult equivalents used are shown in table 3:

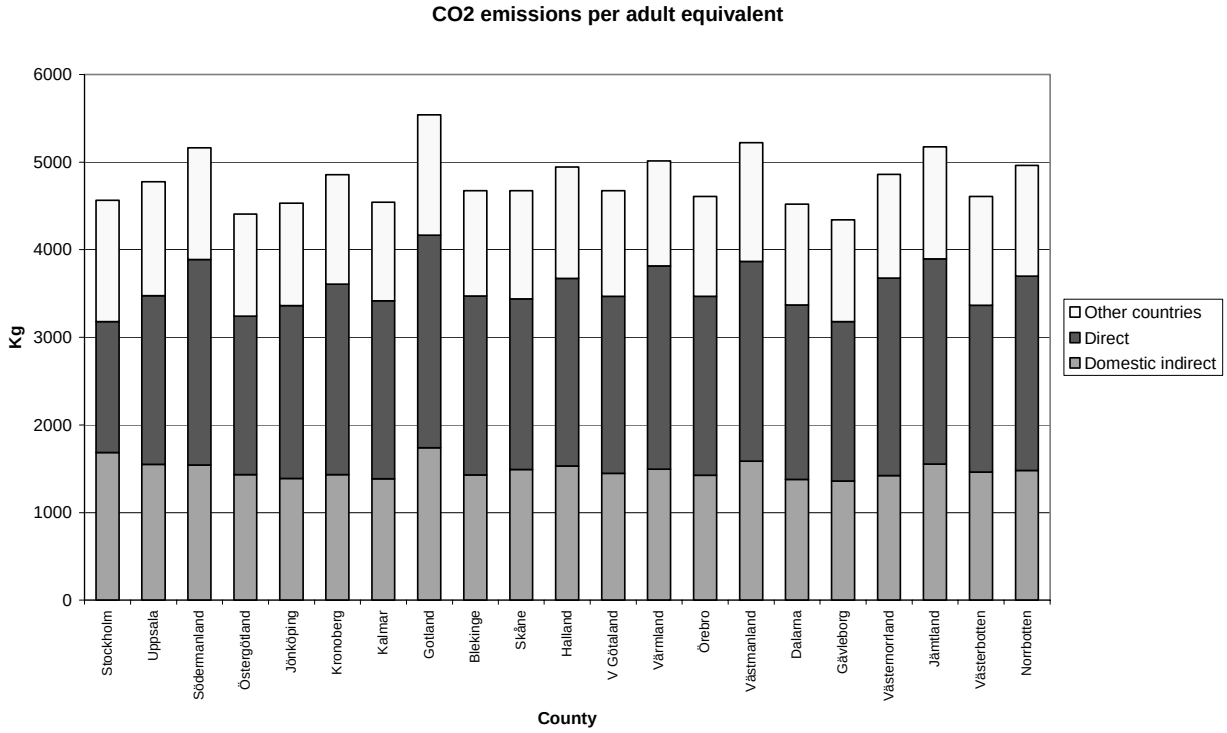
Table 3. The adult equivalents used in HBS 1999-2001[20]

Single person	1,16
Cohabiting adults	1,92
Additional adult	0,96
Children up to 3 years	0,56
Children 4-10 years	0,66
Children 11-17 years	0,76

Children between 18-19 years living at home are considered to be adults.

Diagram 7 below illustrates the total CO2 emissions in 2000 per adult equivalents.

Diagram 7. CO2 emissions per adult equivalent, 2000



Four counties emit more than 5 000 kilo per adult equivalent. These are Gotland, the county with the highest CO2 emissions per adult equivalent, followed by Västmanland, Jämtland and Södermanland. The result differ from diagram 6, using per million SEK, since it evens out the large difference between household types.

Using per adult equivalent seem to be the best way of distributing the emissions to make the data the most justice, considering the consumption by different members in a household. In the

[20] These adult equivalents used are the recommended by the National Board of Health and Welfare when calculations of social assistance are made.

following part of the chapter per adult equivalent is used to translate the total emissions on household types, type of dwelling and income deciles.

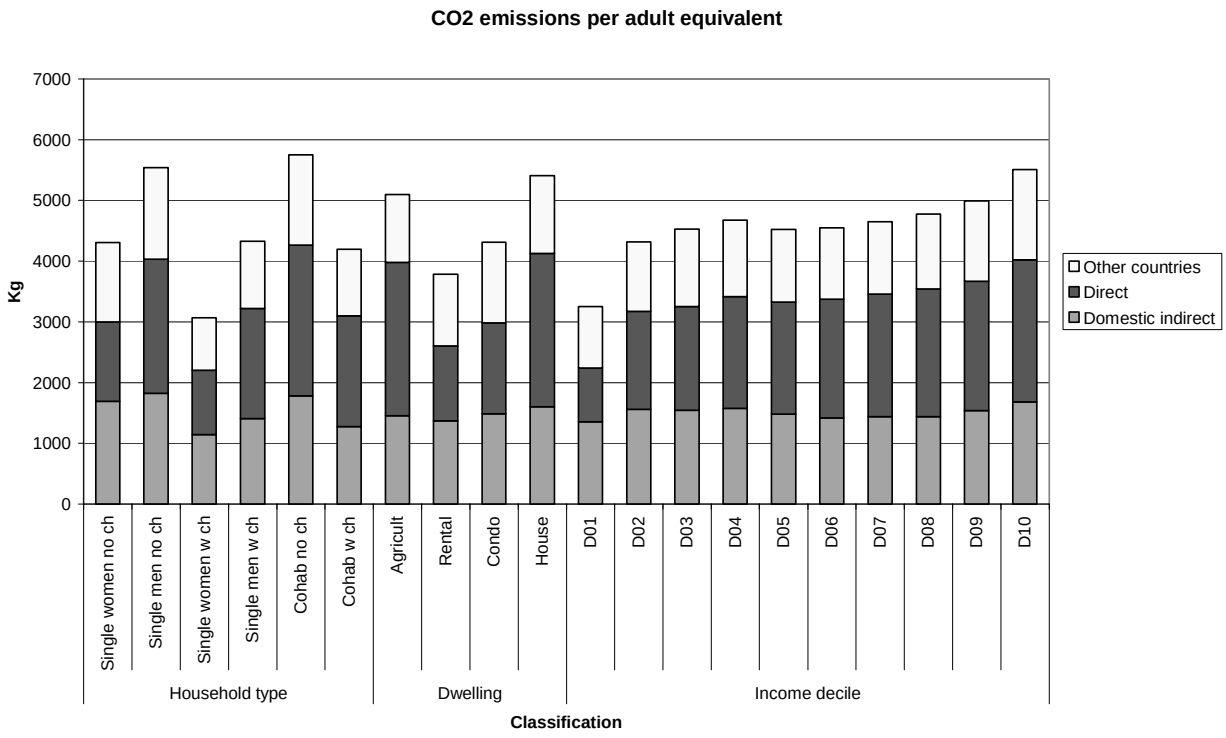
4.3 Household type, dwelling and income

The difference between the rankings of the emissions in terms of total, per household or per million SEK expenditures illustrates the need to chose a focus when presenting the environmental impact of consumption. In this section per adult equivalent is used. The emissions are distributed on household types, types of dwelling and income deciles.

Diagram 8 show the total CO2 emissions per adult equivalent. It can be divided into three different parts which are all described below.

A single woman with children, living in a rental apartment and earning a low disposable income seem to be having the best impact on the environment, as for CO2 emissions.

Diagram 8. CO2 emissions per adult equivalent, 2000



4.3.1 Household types

There are six different household types in diagram 8; single women without children, single men without children, single women with children, single men with children, cohabs without children and cohabs with children. The HBS also make it possible to separate between having one, two, three as well as four or more children but that option is not used here.

The main part of total emissions per adult equivalent comes from cohabs with no children, followed by single men with no children. The result would be different if it showed total emissions instead of per adult equivalent. Then the cohabs with children would have a larger part of the total emissions due to just being more members in the family. Since it is assumed that a child do not contribute as much as an adult to total emissions it is not the best measure.

Single women with no children has the largest share of domestic indirect emissions, from consumption, 39 per cent. Cohabs with children had the lowest share of indirect emissions, followed by cohabs without children. On the other side, cohabs had the largest share of the direct emissions, heating of houses and driving, 43 per cent. For the direct emissions the single woman without children had the lowest share, only 30 per cent.

Single men and single women without children differ from each other, with the men having a larger environmental from heating and driving than the women do.

The share of the indirect emissions from other countries are more uniform, between 26 to 30 per cent of the total emissions for all household types.

To answer what it is in the way single women with children live that leads to the better environmental impact, the method of decomposition can be used. See more in *chapter 5*. There are two perspectives to this question, either the volume in consumption or its composition can cause different levels of emissions. The following sections focus on different types of dwelling and incomes which also can explain the lesser impact from this household type.

4.3.2 Type of dwelling

There are four different types of dwelling in diagram 8; agricultural properties, rental apartments, condos and houses.

Households in houses are responsible for the most of the total CO2 emissions per adult equivalent, followed by agricultural properties. Households in rentals are responsible for the least of the total CO2 emissions.

The shares between direct and indirect emissions are interesting to follow up. As to direct emissions agricultural properties and houses have a share of 50 respectively 47 per cent of its total emissions. Heating their, in comparison, larger living areas is probably one of the reasons.

Other possible explanations of the higher direct emissions from these types of dwelling are the possession and use of private cars. Houses and agricultural properties are often situated in the countryside while rental and condo apartments more often are situated closer to the city/village centres which may be another explanation. Finally the correlation between disposable income and type of dwelling is likely to affect the outcome.

Regarding the indirect emission from consumption it is a larger share of households living in rental and condo apartments, 36 and 34 per cent of its total CO2 emission. The same result

follows for emissions due to consumption in other countries, a lower share for agricultural properties and houses than apartments.

4.3.3 Income deciles

The income deciles are classified in ten groups with the lowest disposable income in decile one and the highest in decile ten.

Diagram 8 demonstrates that large disposable income goes hand in hand with large CO2 emissions. The tenth of the households with the largest disposable income (decile 10) account for around 12 per cent of the total CO2 emissions per adult eqivalent. The tenth with the lowest income (decile 1) account for only 7 per cent.

The share of domestic indirect emissions tend to decrease with increased disposable income while, on the other hand, direct emissions tend to increase with increasing income. For income decile one the indirect domestic emissions is around 42 per cent of the total emission from the decile and the same share for decile ten is around 31 per cent.

Concerning indirect emissions in other countries, due to consumption in Sweden, the share in decile one is 31 per cent of the total emissions in the decile, and 27 per cent for the richest decile (10).

A question close at hand is what is causing different levels of emissions. Is it basically based on a change in the volume or can it be a change in structure that explains some of the change? Chapter five will try to explain this. The chapter begins with explaining decomposition and presenting time series for 1993 to 2000 before going back to how the diagrams presented in this chapter can be analysed.

5 Decomposition

The previous chapter presented the total CO2 emission distributed with a focus of regional, income, family situation and type of dwelling. In this chapter we will further explain the development of private consumption by using a method named decomposition. It will show to what degree the environmental impact from households depend on the volume of the consumption as well as on how the consumption is made up.

Section 5.2 will explain the method of decomposition by using time series from 1993 to 2000. It will look in to what factors contribute to changes between the years. Following *section 5.3* will continue by looking into year 2000 and the factors behind the results from chapter four.

5.1 Introduction

In the environmental accounts environmental data are linked to economic data in constructive ways. In most cases this means allocating energy use and emissions from fuel use to the industries or to private or public consumption. Over time this produces time series of economic activity and environmental pressures that can be used to analyse the development. Structural decomposition analysis based on input output modeling can, combined with environmental accounts, therefore be used to analyse which underlying factors that are responsible for the shown development.

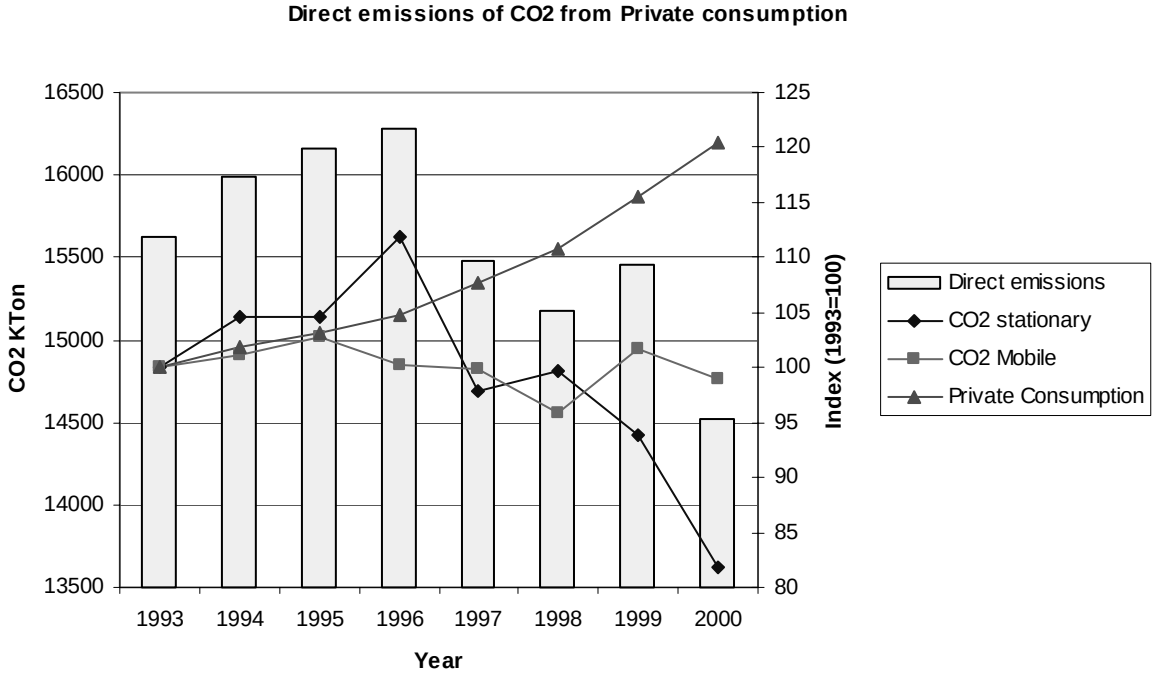
Decomposition is a way to isolate the different factors that add up to a change in emission, energy use or some other variable between two periods. Besides being a useful tool for analyzing changes in the development it can also be useful in the calculation of accounts data[21].

5.1.1 Decoupling can be explained

In diagram 9 the direct emissions of CO2 (i.e. attributed directly to private consumption) is displayed together with the development of private consumption. The direct emission of CO2 is broken up on stationary and mobile sources. It should be noted that the stacks begin from 13 500 Kton CO2, not zero.

[21] For more information about structural decomposition see Eurostat report*: Structural decomposition of environmental accounts data – the Swedish case*. (Wadeskog and Palm 2004)

Diagram 9. Development of direct emissions of CO2 and private consumption, 1993-2000



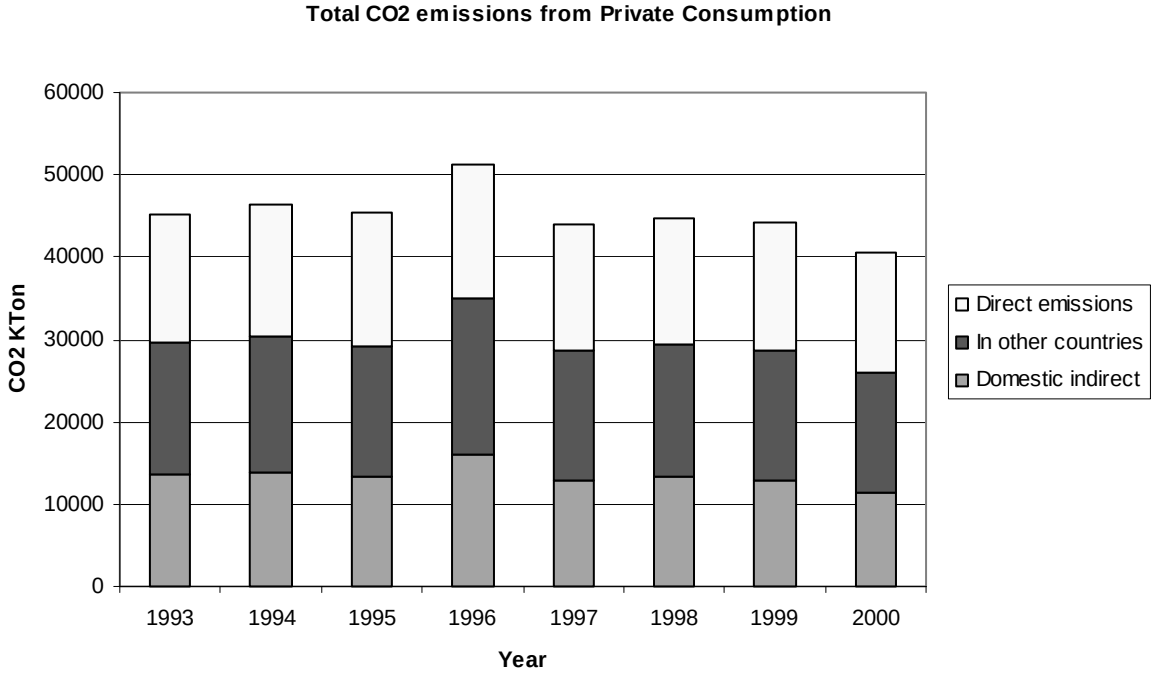
The bars show the sum of stationary (heating) and mobile (transport) emissions in KTons and the lines show the development as an index with 1993 as 100. There is apparently a decoupling between private consumption and the direct emissions of CO2 it causes, especially for the stationary emissions of CO2 in the latter part of the 1990's.

Decomposition can answer the question of why, in this case, a decoupling has occurred. However, direct emissions are only abut one third of the total emissions from households, as was showed in chapter four.

5.1.2 Total CO2 emissions

Diagram 10 illustrates the total CO2 emissions per Kton for the period 1993-2000, that is the direct emissions from private consumption together with the indirect domestic emissions and emissions in other countries. The different types of emissions were explained in *section 4.1*. This gives a more complete picture of the emissions caused by private consumption than diagram 9 above.

Diagram 10. Total CO2 emissions from private consumption per Kton, 1993-2000



Although the trend over time is roughly the same, the levels are substantially different and the augmented series poses interesting questions about an international division not only of labour, but also of emissions. It is therefore interesting to try to understand what, if anything, in private consumption that is changing over time.

One way to proceed with such an inquiry is to use structural decomposition analysis to allocate different parts of a certain change to different components that are involved. As an example of decomposition the *indirect domestic* CO2 emissions will be analysed in the next section. A decomposition of the direct CO2 emissions can at this stage not be carried out due to a current lack of data. To decompose the direct CO2 emissions we need to add data on, for example, energy per square meter for the stationary emissions and passenger per kilometer for the mobile sources.

5.2 CO2 decomposition 1993-2000

What is it in private consumption that is changing over time, that is, what lies behind the apparent decoupling in diagram 9 above? This section will analyse how different factors contribute to changes in emissions between years, by looking in to *indirect domestic* CO2 emissions as an example.

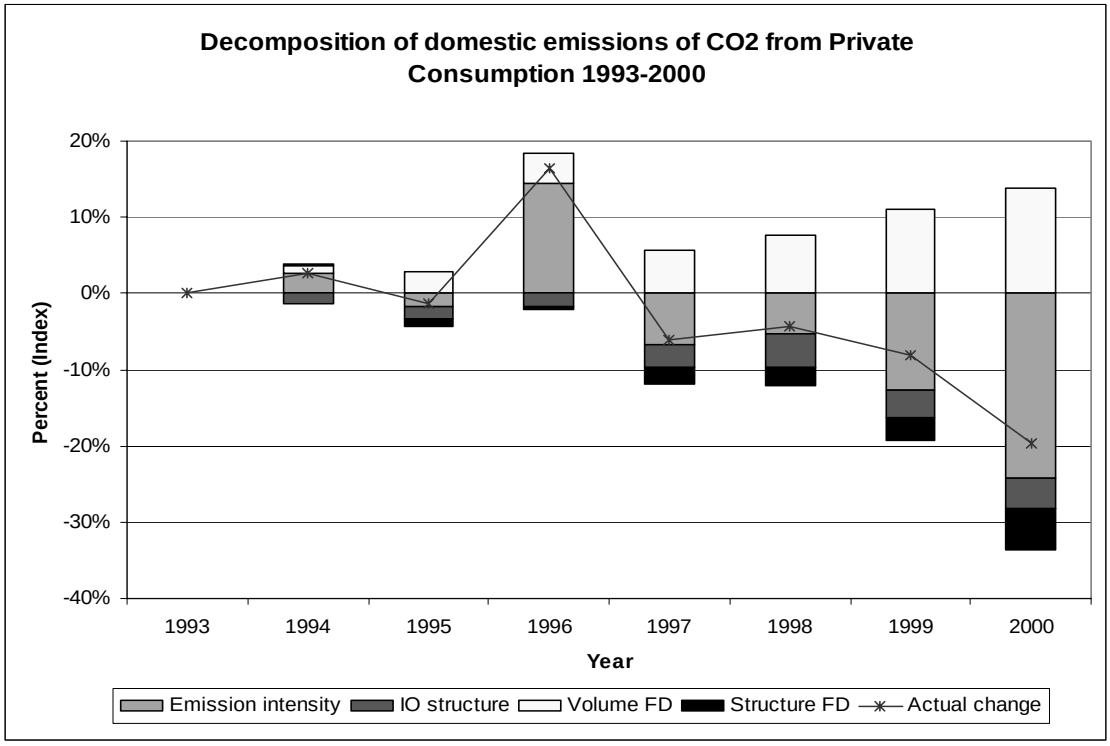
As mentioned above, structural decomposition analysis is in a way to allocate different parts of a certain change to different components that are involved. In this case it can be the change in **volume** of private consumption (i.e. growth), the **composition** of consumption (for instance more services and less goods), the **structure** of the economy (links between industries, import content) and finally the energy or **emission intensity** of production (ton per million SEK of produced).

This expansion and deepening of the view of the role of households in terms of environmental pressures is possible to do with the help of IO tables from the national and environmental accounts.

5.2.1 Indirect domestic CO2 emissions 1993-2000

Diagram 11 shows a decomposition of Swedish environmental accounts data for indirect domestic CO2 emissions over the period 1993-2000, by using the four factors, volume, composition, structure of economy and emission intensity. The bars illustrate the contribution from each of the four factors and the line shows the actual development in emissions of CO2 with 1993 as a base year.

Diagram 11. Decomposition of domestic CO2 emissions, 1993-2000



Over the whole period, *indirect domestic* CO2 emissions decreased by 20 per cent from 1993 to 2000[22]. The volume of consumption on its own would have caused an almost 15 per cent increase, but was counteracted by improvements in emissions intensities in the production of the products that are important in private consumption as well as a more environmentally friendly production structure and structure of private consumption in itself.

One could say that Swedish households are adopting a more environmentally friendly consumption pattern, helped by Swedish industry adopting more environmentally friendly production methods, regarding CO2.

[22] The peak in 1996 was due to dry and cold weather. Decreasing water power supply meant increased use of fossile fuels.

The next section continues with the method of decomposition but solely on the year 2000.

5.3 Decomposition of CO2 emissions for 2000

After this introduction in decomposition with examples from 1993 to 2000 this section will use the same method to analyse some of the former results from *chapter 4* further. This time only with the year 2000 in focus. In this section the volume and structure of expenditure and the related emissions for each household type, county etc. is related to, and decomposed on, the average for that classification. All is based on data for 2000.

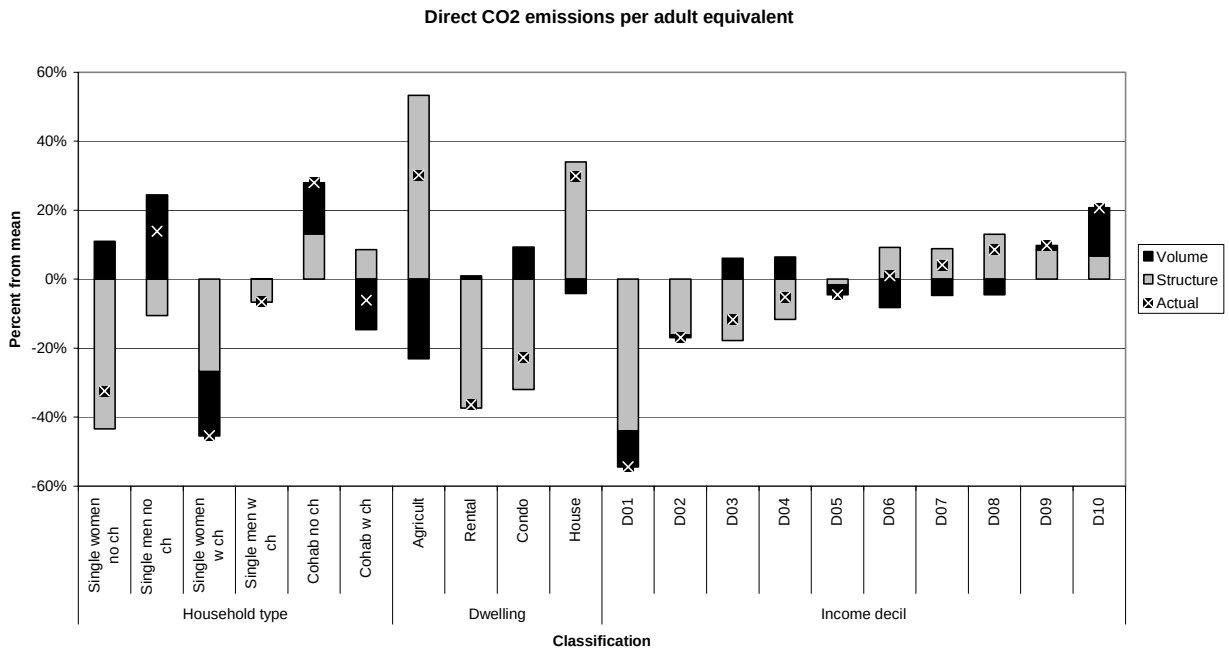
Decomposition of *direct* CO2 emissions in 2000 is presented below, and diagrams of the decomposition of indirect CO2 emissions and CO2 emissions in other countries (for 2000) are presented in *appendix for chapter 5*.

We will only isolate change in volume and from structure in this section. A change in volume of consumption means more consumption. A change in structure means changes in the private consumption in itself, i.e. changes in what goods and services that are consumed.

5.3.1 Direct emissions

Diagram 12 illustrates the direct CO2 emission in 2000, per adult equivalent. It shows the CO2 emissions per household type, dwelling and income decile. Direct CO2 emissions by counties follows in diagram 13.

Diagram 12. Direct CO2 emission per adult equivalent, 2000



Household type

The actual change in direct CO2 emissions for different household types during 2000 has varied depending on type of household.

As shown in diagram 12 the two changes have had different impact on the actual change in direct CO2 emissions. The change in volume itself would have led to increases in CO2 emissions for some types and for a decrease for others.

It has increased for two family compositions; single men with children and cohabs without children. Direct CO2 emissions have decreased for the other household types in diagram x, the maximum decrease of 45 per cent for the group single women with children. This decrease was a result of a decreasing change in volume as well as a change in the composition of consumption.

The volume of consumption on its own caused an increase for all family structures besides for single women with children and cohabs with children. For the group single men without children the change in volume was responsible for the 14 per cent increase in direct CO2 emissions. Without improvements in the groups structure of private consumption the increase would have been even larger.

Single women without children had an actual change in direct CO2 emissions in about a 30 per cent reduction. The volume of consumption on its own would have caused a 10 per cent increase in emissions, which also here was held back by the structural change in final demand. So their changes in consumption structure are responsible for the CO2 decrease.

Dwelling

The actual change in direct CO2 emissions have increased for households living in agricultural properties and houses. It has decreased for rental and condo apartments.

The volume of consumption on its own would have caused an decrease in emissions for agricultural properties and houses but was counteracted by changes in the structure of private consumption. However, this change in structure was responsible for the decrease in direct CO2 emissions in rentals and condos.

Income decile

The last classification in diagram 12 was income deciles where the actual change in direct CO2 emissions has increased with income (with first decile being the poorest and the tenth the richest).

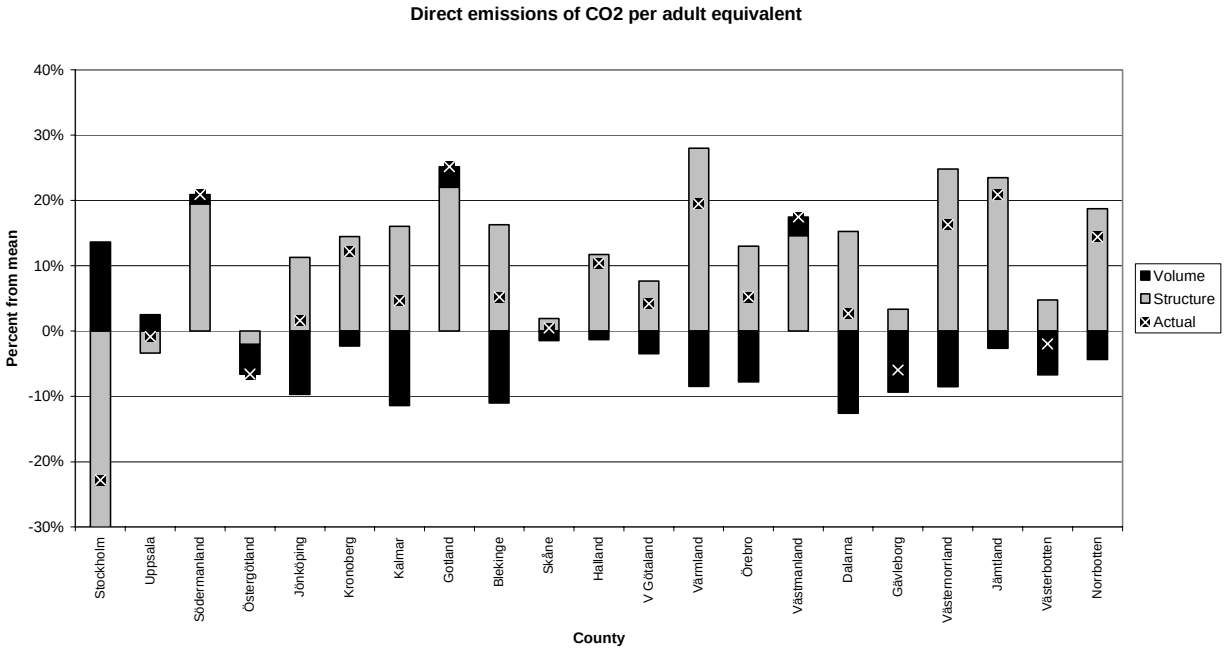
For households in the lowest five deciles the change in the structure of consumption is the main reason for the decreasing CO2 emissions. For households in the upper deciles the same changes has instead resulted in increasing CO2 emissions.

The volume of consumption on its own would have caused a different result than the actual change for income deciles 3, 4, 6, 7 and 8.

By counties

Diagram 13 illustrates the direct CO2 emissions by counties.

Diagram 13. Direct CO2 emission per adult equivalent, 2000 – by counties



The structural change in final demand, that is from the composition of consumption, has had an contribution to the increase in emissions in many of the counties, as showed in the diagram above. There are only three exceptions to this, Stockholm, Uppsala and Östergötland. These counties are also, together with the counties of Gävleborg and Västerbotten, the only counties with an decreasing actual change in direct CO2 emissions.

The change in volume have had a dampening effect on the direct CO2 emissions in many of the counties, where the change in structure in itself would have led to a higher increase in direct CO2 emissions.

Stockholm is only county that distinguishes itself from the rest, with the actual change being an almost 23 per cent decrease. The volume of consumption on its own would have caused an almost 14 per cent increase so the method by which the county of Stockholm compounded their consumption contributed to the actual decrease. The average in 2000, for all counties, was an 6,8 per cent increase in direct CO2 emissions.

6. Households and the activities they perform

This chapter focus on activities performed by households and how the choices they make in their daily life affect their environmental impact. We look at the activities that influence their expenditures and thereby the pressure they make on the environment. The basic reason for this perspective is that it is analogous to the way we look at the production side of the economy in the environmental accounts. Emissions in production are linked to the activities of the different industries. The way they structure their activities determines their use of inputs and thereby their environmental pressure. As much of the value adding is done by the households, it should be of interest to se them as productive units that perform activities that influence the environment.

Although it is hard to find measures of how activities in the household affect expenditure patterns and vice versa, it is important to pursue these links as they are crucial in the idea of households adapting to a more sustainable consumption.

As in most other countries, the data at our disposal consists of environmental accounts data on the one hand, and several individual/household based surveys. In our case we combine results from the Household Budget Surveys (as in previous chapters) with additional data from a Time Use Survey. Aside from more qualitative surveys these try to quantify both expenditures and activities in a way that is supposed to reflect the actual choices made in everyday life –not the attitudes to these choices.

Although possible in principle, we do not disaggregate the analysis in this chapter into different household types as in previous chapters. The idea is more to illustrate the possible linkages and ways to look at the environmental pressures of households from an activity perspective. The data at our disposal at the moment would not support to much detail in the analysis. Hopefully this will change in the future.

It is important to point out that the activity analysis of households does not change the size of total emission from the households, they are still the same as the ones taken from the environmental accounts, but it does give a picture of the choices in every day life can influence these emissions or how changes in everyday life can contribute to a sustainable development.

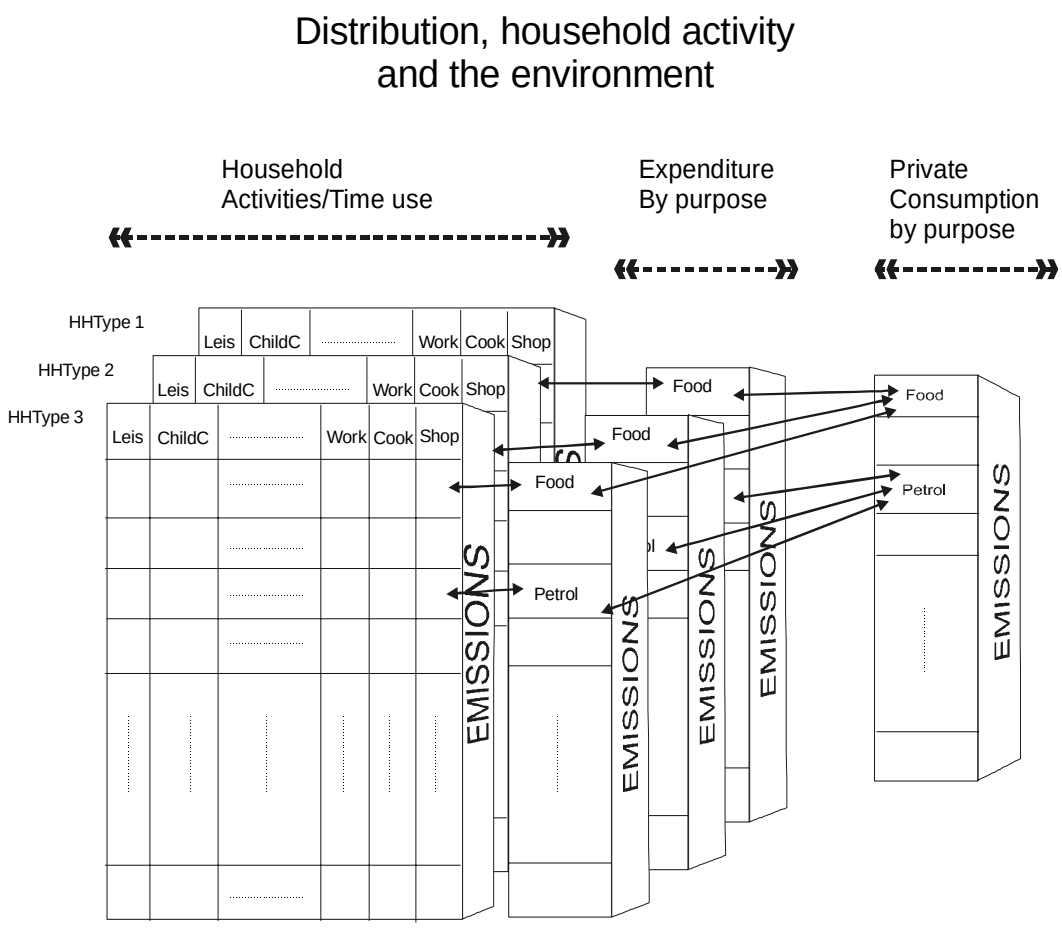
6.1 The general idea

We chose to view the household as a producing unit. They produce cleaning, care, meals, repairs and transport much the same way that industries produce them. As many of the products produced in households have market equivalents, household production can be set up as a satellite system to the national accounts, parallel to the environmental accounts.

The usual way to measure household production is to start out from a time use survey (TUS) where a number of productive activities can be identified. Given this the work effort can be valued either by imputing a wage to each hour worked or to calculate a real wage by using prices from market equivalents. Once a wage cost has been calculated or imputed we end up with something that is similar to a value added calculated for much of the non market production in the public sector.

In *chapter 2* we illustrated how households combine time and expenditures to produce welfare. The following diagram illustrates the same thing from a more statistical perspective where data from TUS, HBS and Input-Output calculated data from the environmental accounts are linked to arrive at a quantitative analysis of activity pattern and environmental pressures for different household types. The specific data used is also described in *chapter 2.*

Diagram 14. Household activities and NAMEA



The expenditures are allocated over activities/time use, e.g. how much of the expenditure of a good is used on the activity that follows. For example the expenditure on petrol when driving to work or day-care.

6.2 What activities are productive?

One of the key issues in seeing the household not only as a consumption unit but also as a production unit is to decide what activities that is to be counted as productive in an accounting sense. There are obviously several non productive hours in a day, when we for example sleep or watch television. Preparing a meal for the family or fixing the car, on the other hand, are clearly productive. One way to decide when a activity is to be classified as productive or not is to apply the so called “third-party-criteria”. The most common interpretation of this criteria is:

"If any activity is of such character that it might be delegated to a paid worker, then that activity shall be deemed productive[23]"

A more narrow interpretation is:

"..those economic services produced in the household and outside the market, but which could be produced by a third person hired on the market without changing their utility to members of the household[24]."

The difference between these two criteria may seem small but they do differ. Regarding the first version it is possible to consider all child care at home equal to the public or private child care while the second criteria opens up for differences between the different options as it says that there may be an added value with the professional day care, as well as more utility from an activity performed in the household.

Although the focus here is on the productive activities of the household it is important to note that expenditures and the associated environmental pressures are due to all activities in the household – whether they are classified as productive or not. Energy for heating is needed both for productive activities and for sleeping. So the direct and indirect emissions caused by household expenditures that was described earlier applies to both productive and non-productive activities. The main idea with the present analysis is to allocate expenditures over different activities that are classified according to whether they are productive or not.

6.3 General view of activities and environmental impact

Also the non paid work in the household uses energy, raw material and production inputs which have an impact on the environment just like the production carried out by the market. The use of time and income in the household affect the environment and changes in that time and income can change their total impact on the environment. A picture showing the links between household activities and emissions was presented in the method, *section 2.3*.

Private consumption can be broken down on two components. One part is the final consumption of goods and services in the households, goods and services that are not wider refined. The other part is expenditures for goods and services with the primary use to become production inputs in a *value added chain* that continues in the household. Examples of the latter are meat, flour and rice which require preparation as well as petrol needed to carry out different kinds of transports.

However, including this (new) household production sector in the national accounts is not possible due to the fact that there is no information of the produced added value. Therefore the following calculations are made as a satellite system and not in the national accounts.

[23] Goldschmidt-Clermont (1982) *Unpaid work in the household*

[24] Hawrylyshyn (1978) *Estimating the value of household work in Canada*

6.4 Households and their activities

In this report we have calculated a rough example of a Environmentally extended Household Production Satellite Account using the 1990/91 time use survey and the 1992 Household Budget Survey and 1991/1993 data from the environmental accounts.

Table 4 presents the result from calculations of emissions for an aggregate of households and their activities. The indirect emissions follow the shares of expenditures quite well, with an exception for household production that have a larger share of the emissions than from the expenditures. This can probably be explained by the relatively higher emission intensity of expenditure on food that is mainly allocated to household production. Only transports and household energy are actually higher. Travel to and from work explains the high share of direct emissions allocated to wage work.

Table 4. Time use, expenditures and emissions, 1991. SEK million.

	Work	Household production	Personal time	Studies	Leisure time	Other	Total
Food, drink, tobacco	0	119228	28866	0	3326	0	151420
Clothing and footwear	9957	7566	22374	666	9576	692	50831
Living expenses (excl energy)	0	32682	96645	2875	41366	2989	176557
Energy	0	7051	20851	620	8924	645	38091
Petrol	8317	10199	446	371	7068	1958	28359
Furniture & hh textiles	0	4796	14184	422	6071	439	25912
Househ articles	0	3545	10482	312	4487	324	19150
Various services	0	23781	5437	162	2327	168	31875
Vehicles	16655	20425	893	743	14155	3921	56792
Other transports (bus, rail, air)	8010	2577	265	838	2319	9633	23643
Post/tele communication	0	2673	7904	235	3383	244	14439
Leisure eqipment	0	0	18105	0	36181	0	54286
Entertainment	0	0	0	0	23126	0	23126
Education and literature	0	0	0	5018	7827	0	12845
Restaurant and Hotel	0	0	0	0	30103	0	30103
Total expenditures	42939	234523	226452	12261	200240	21015	737429
Share of expenditures (%)	6%	32%	31%	2%	27%	3%	100%
CO2 KTon - Indirect	1350	6232	5065	319	4017	1231	18214
Share of emission (%)	7%	34%	28%	2%	22%	7%	100%
SO2 Ton - Indirect	2636	10060	9788	701	7552	2460	33196
Share of emission (%)	8%	30%	29%	2%	23%	7%	100%
Nox Ton - Indirect	10354	40694	21683	2113	22595	9773	107211
Share of emission (%)	10%	38%	20%	2%	21%	9%	100%
CO2 KTon - Direct	3946	4414	2212	196	3456	778	15003
Share of emission (%)	26%	29%	15%	1%	23%	5%	100%
SO2 Ton - Direct	1878	1638	3224	115	1755	206	8816
Share of emission (%)	21%	19%	37%	1%	20%	2%	100%
Nox Ton - Direct	31048	37378	4943	1418	26554	7062	108404
Share of emission (%)	29%	34%	5%	1%	24%	7%	100%

One of the most important determinants of the direct emissions is expenditure on petrol. The TUS codes travel time by mode of transport and this has been used to allocate petrol expenditures to the activities that the transport is caused by.

This rough calculation is not enough to say something about what the effects on everyday would be if, for example, the CO2 emissions would decrease with, say 10 per cent. To be able to say something about that we would need to have expenditures as well as time use disaggregated on different households types, region, type of dwelling etc. This would at least make it possible to do the same kind of decomposition that was made in the previous chapter concerning the structure and volume of expenditures and emissions for different household classifications.

6.5 Environmental pressure from household production

It is possible to disaggregate the household production column in table 4 above. This is done in table 5 below, where additional data is included on hours worked and an imputed value added based on wage is what it was for a municipal housekeeper for the years in question - 70 SEK an Hour[25].

If comparing emission intensities per million worked hours, cooking and shopping seem to have the highest environmental impact. Also child care has a large impact, mainly by NOx emission, which is probably due to the higher transport intensities in these activities. Both cleaning and maintenance have lower emission intensities.

The activities differ substantially when looking at the differences between the direct and indirect emission. Emissions from cooking primarily come in the form of indirect emission in the production of the inputs. Childcare and shopping on the other hand comes out high in direct emission, once again due to the higher transport content in these activities.

25 For a further discussion on the relevant wage Cf Goldschmidt-Clermont L "Monetary Valuation of Non-market Productive Time: Methodological Considerations," *Review of Income and Wealth*, Series 39, No.4, December 1993; Gronau R, "The Intrafamily Allocation of Time: The Value of Housewives Time," *American Economic Review*, Vol.63, No.4, September 1973; Heckman J, "Shadow Prices, Market Wages and Labor Supply," *Econometrica*, Vol.42, No.4, July 1974., Waring M, *Counting for Nothing: What Men Value and What Women are Worth*, Wellington, New Zealand, 1988.

Table 5 Household production, expenditures and emissions 1991.

	Household production				
	Cooking	Cleaning	Maintenence	Child care	Shopping etc.
Food, drink, tobacco	119228	0	0	0	0
Clothing and footwear	2121	1702	1094	1498	1150
Living expenses (excl energy)	9162	7354	4727	6473	4965
Energy	1977	1587	1020	1396	1071
Petrol	370	297	191	3444	5898
Furniture & hh textiles	1345	1079	694	950	729
Househ articles	994	798	513	702	539
Various services	939	753	484	21096	509
Vehicles	740	594	382	6897	11811
Other transports (bus, rail, air)	3	2	1	288	2283
Post/tele communication	749	601	387	529	406
Leisure eqipment	0	0	0	0	0
Entertainment	0	0	0	0	0
Education and literature	0	0	0	0	0
Restaurant and Hotel	0	0	0	0	0
Total	**137628**	**14768**	**9493**	**43274**	**29361**
CO2 KTon - Indirekt	4151	350	225	775	731
SO2 Ton - Indirekt	6107	680	437	1395	1441
Nox Ton - Indirekt	29294	1413	908	4513	4565
CO2 KTon - Direkt	507	156	100	1394	2257
SO2 Ton - Direkt	350	243	157	402	486
Nox Ton - Direkt	3364	256	164	12463	21131
Million hours	1696	1361	875	1403	1400
Emissions KTon CO2 / million hours	2,7	0,4	0,4	1,5	2,1
Emissions Ton SO2 / million hours	3,8	0,7	0,7	1,3	1,4
Emissions Ton NOx / million hours	19,3	1,2	1,2	12,1	18,4
Value added SEK m (70 SEK/hour)	118692	95264	61237	98229	97970
Emission KTon CO2 / m Value added	0,04	0,01	0,01	0,02	0,03
Emission Ton SO2 / m Value added	0,05	0,01	0,01	0,02	0,02
Emissions Ton NOx / m Value added	0,28	0,02	0,02	0,17	0,26

Indirect emissions and expenditures on the last four expenditure categories do not enter the household production activities in this table. They are nor seen as inputs into household production.

6.5.1 Household and market production

One purpose of making household production accounts is to compare household production with market production in terms of output and substitution between the two spheres over time. This also has an environmental side where it would be interesting to be able to compare the emissions from household production with the emissions from equivalent market production. In the discussions on sustainable development it has sometimes been argued expressed that small-

scale activities (i.e. in the local economy or in the households) are environmentally beneficial compared to large-scale activities.

Despite the obvious problems in finding identical products in the household and market economy, a rough comparison can be made between the production of products in households and on the market. The environmental accounts include emission per value added or hours worked in different industry profiles. These can be used to compare the emissions and hours worked and value added calculated for household production in the table above.

We have selected the following pairing of products/activities to make the comparison between the environmental intensities of household production and market production.

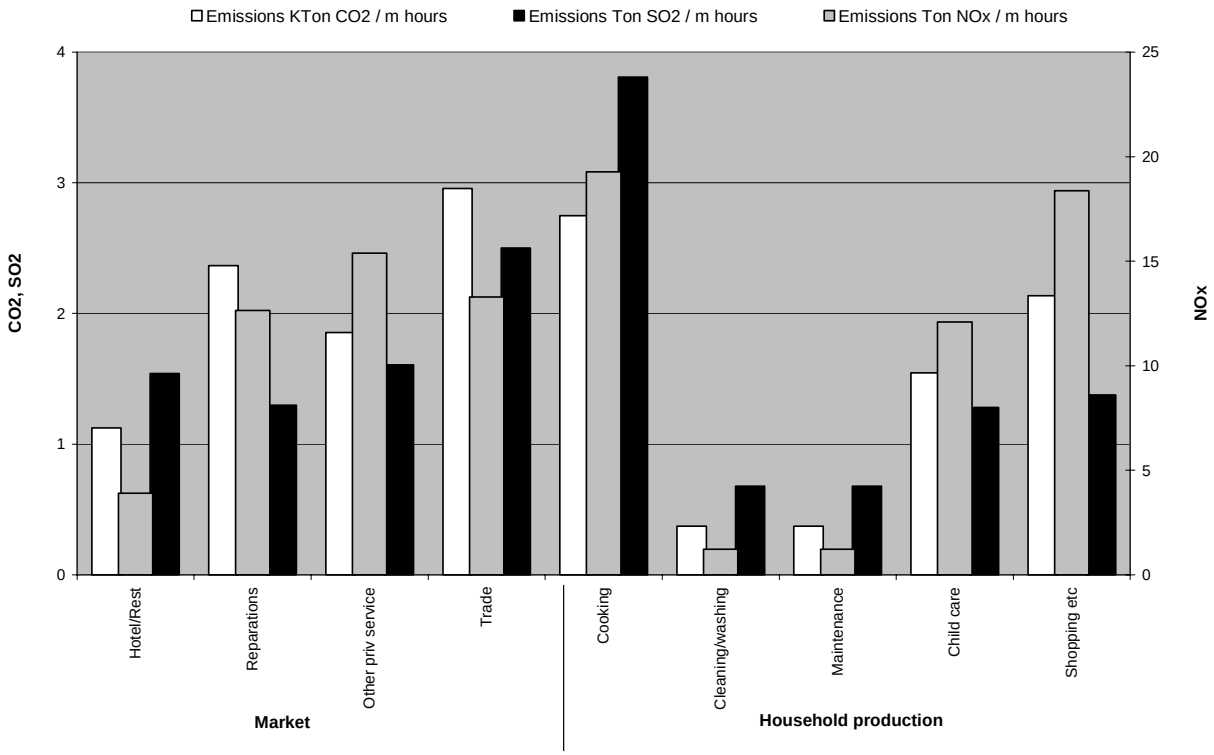
Market production	**Household production**
Hotel /restaurant	Cooking
Hotel/restaurant	Cleaning
Reparations	maintenance
Other private service	Child care
Trade	Shopping etc.

Diagram 15 presents the results of this exercise in terms of environmental pressure per hours worked. Emissions per product in the market are calculated from the use side, i.e. all upstream emissions from the production of these goods and services are included. Input-output analysis has also been used to reallocate hours worked per industry to hours worked per product purchased in private final demand.

It is worth noting that consumption of market products often requires household production to support them. Consumers must, for example, transport themselves to the hotel or the restaurant in order to be able to consume. The same goes for child-care, retail trade and most personal services. Thus, most market products consumed includes production activities in the household. Emissions calculated for equivalent products in the household already include most of these additional activities, which makes the comparison come out unfavourably for household production.

The left hand scale refer to emissions in CO2 (Kton) and SO2 (Ton) and the right hand scale is for NOx (Ton).

Diagram 15. Emission intensities per million worked hours, in the market and in households. 1991



Cooking has a large intensity in household production, while cleaning etc. has a relatively low intensity. The comparison with hotel/restaurant in the market therefore depends on the proportion between these different activities in the market. Child care performed in households seem to have a lower emission intensity than care and other personal services in the market.

The difference between maintenance in the household and the repairs done in the market probably reflect the different labour intensities and productivities. Household production is less specialized and probably less capital end energy intensive.

6.6 Final words

Unfortunately, the data at our disposal today do not really facilitate the types of analysis presented here. Therefore, the results presented should be seen as examples of what could be done with the proper data.

The role of the household as a production unit is interesting to pursue further in the environmental accounts. It would not change the calculation of the emissions generated by household through private consumption that is presented in the accounts. It would, however, make it possible to shed some light on how changes in life-style or organisation of every day life that appears to be important in adapting to a more sustainable consumption pattern.

7 Future work households

The present study includes analysis and material that in some cases are part of the routine work within the environmental accounts and in others are examples of what we would like to be doing in the future given the right circumstances.

The Input-Output based calculations on domestic indirect emissions as well as emissions in other countries are done on a regular basis. Further development within Eurostat to harmonize and develop the environmental accounts and Input-Output Data will open up for more detailed analysis specifically on the relationship between trade and emissions in different countries. Until then we (and others) will have to continue to calculate emission shifting between trading partners in the simplified way used in this report.

Different disaggregations of the emissions from private consumption depend on relevant data from household surveys on expenditure and income. As stated previously recent development in these surveys in Sweden looks very promising in terms of inclusion of environmentally specific information as well as a better understanding of the importance of energy related expenditures and other directly environmentally relevant expenditures. Possibilities for disaggregation over household types, is directly related to the size of the samples. Presently the yearly sample is not big enough to facilitate very detailed break-downs. For the present study this was solved by using several years of data. This will continue to be the case.

Decomposition analysis is also incorporated in the routine work at the environmental accounts on the macro level, i.e. looking at Final Demand in total or private consumption as in this report. The decomposition done on household data will probably also be done more in the future as the Household Budget Surveys develop.

One area that was sorely lacking in this report, but will be part of the routine work in the future is decomposition of the direct emissions from private consumption. To do this we have to add data on population, household size, area of dwellings, persons per m2, energy per m2 etc. for the stationary emissions and similar data but for cars, passenger km etc for the mobile emissions.

Regarding time use surveys, the data at our disposal today do not really facilitate the types of analysis presented in this report. Therefore should the results presented here be seen as examples of what could be done with the proper data.

The role of the household as a production unit is interesting to pursue further in the environmental accounts. It would make it possible to shed some light on how changes in life-style or organisation of every day life that appears to be important in adapting to a more sustainable consumption pattern.

We have relied on existing time use survey data and household expenditure data to establish the links between household activities and environmental pressures. Recent developments in the household budget and income surveys, described earlier, shows an increasing interest in including variables that will give the connection between income/expenditures and environmental pressures more focus. This should make them more useful for further analysis in the environmental accounts in the future.

As for time use surveys and the links to environmental pressures, the most interesting development would be to attach a simplified (but more structured) time use module to expenditure surveys. This has been discussed but has often been rejected on account of the added response burden and the fear that this would mean a decrease in the (already low) response rates for household budget surveys. However, the methods for collecting the information is constantly evolving, so hopefully the situation will change in the not to distant future.

The Income Distribution Survey described in *chapter 2* is an interesting survey for future analyses, especially since the survey contain information on households use and expenditures on public services.

Future studies could also consider type of vehicle, total transport volume, urban or rural driving, climate etc. from the National Travel Survey (NTS). There may be a lot of interesting variables in future NTS.

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Appendix to chapter 3 – international outlook

Table A. Environmental Pressures and Performance Score by Family Types, Denmark 1997. The table shows the average contribution per DKK 1 000 aggregate consumption.

	Acidif- ication		Green-house Effect		Ozone depletion		Photo-chemical Oxidation		Water Use		Total Material require-ment		Cadmium		PAH's		Environ-mental Perfor-mance Score	
	mol per 1000 DKK		kg per 1000 DKK		mg per 1000 DKK		g per 1000 DKK		m3 per 1000 DKK		kg per 1000 DKK		mg per 1000 DKK		mg per 1000 DKK		%	
Low income																		
Young																		
Urban flat	12	*(5)*	83	*(5)*	98	*(10)*	72	*(5)*	1.00	*(12)*	293	*(4)*	0.9	*(15)*	4.0	*(15)*	102	*(14)*
Urban house	13	*(17)*	91	*(14)*	96	*(7)*	89	*(11)*	1.00	*(11)*	309	*(16)*	0.8	*(5)*	3.3	*(7)*	101	*(15)*
Rural house	13	*(18)*	96	*(16)*	96	*(8)*	125	*(26)*	0.77	*(3)*	302	*(9)*	0.9	*(11)*	3.9	*(13)*	104	*(10)*
Middle-aged																		
Urban flat	12	*(7)*	87	*(8)*	91	*(4)*	73	*(6)*	1.36	*(24)*	294	*(5)*	1.1	*(23)*	5.3	*(25)*	102	*(13)*
Urban house	13	*(16)*	94	*(15)*	90	*(3)*	92	*(13)*	1.09	*(16)*	307	*(13)*	0.8	*(2)*	3.2	*(5)*	105	*(5)*
Rural house	14	*(24)*	110	*(23)*	92	*(6)*	101	*(20)*	0.87	*(6)*	307	*(14)*	0.9	*(13)*	3.4	*(9)*	104	*(7)*
Elderly																		
Urban flat	13	*(12)*	91	*(12)*	90	*(2)*	65	*(3)*	1.40	*(25)*	307	*(12)*	1.3	*(26)*	6.2	*(27)*	104	*(8)*
Urban house	14	*(22)*	109	*(22)*	87	*(1)*	92	*(12)*	1.18	*(20)*	316	*(18)*	1.0	*(20)*	4.3	*(19)*	103	*(12)*
Rural house	15	*(27)*	126	*(27)*	91	*(5)*	98	*(18)*	1.14	*(18)*	339	*(26)*	1.2	*(25)*	5.2	*(23)*	97	*(22)*
Middle income																		
Young																		
Urban flat	12	*(8)*	83	*(4)*	106	*(22)*	98	*(17)*	1.25	*(22)*	300	*(7)*	0.9	*(10)*	4.0	*(14)*	98	*(21)*
Urban house	13	*(13)*	90	*(11)*	111	*(26)*	101	*(19)*	0.87	*(5)*	323	*(22)*	0.8	*(8)*	3.1	*(4)*	103	*(11)*
Rural house	15	*(26)*	110	*(24)*	104	*(18)*	137	*(27)*	0.88	*(7)*	338	*(24)*	0.8	*(3)*	2.9	*(2)*	104	*(9)*
Middle-aged																		
Urban flat	12	*(10)*	84	*(6)*	98	*(11)*	81	*(9)*	1.19	*(21)*	299	*(6)*	0.9	*(16)*	4.2	*(16)*	99	*(19)*
Urban house	14	*(21)*	98	*(20)*	104	*(17)*	103	*(21)*	1.05	*(14)*	322	*(20)*	0.8	*(9)*	3.5	*(10)*	96	*(24)*
Rural house	15	*(25)*	106	*(21)*	101	*(12)*	116	*(25)*	1.02	*(13)*	334	*(23)*	0.8	*(7)*	3.3	*(8)*	97	*(23)*
Elderly																		
Urban flat	12	*(9)*	88	*(9)*	102	*(15)*	77	*(8)*	1.72	*(26)*	306	*(11)*	1.1	*(22)*	5.2	*(24)*	95	*(25)*
Urban house	13	*(15)*	98	*(19)*	104	*(19)*	93	*(15)*	1.07	*(15)*	318	*(19)*	1.0	*(18)*	4.2	*(18)*	93	*(26)*
Rural house	14	*(20)*	113	*(25)*	107	*(23)*	111	*(23)*	1.25	*(23)*	360	*(27)*	1.2	*(24)*	5.5	*(26)*	89	*(27)*
High Income																		
Young																		
Urban flat	9	*(1)*	66	*(1)*	107	*(24)*	41	*(1)*	1.17	*(19)*	286	*(1)*	0.9	*(14)*	3.8	*(12)*	156	*(1)*
Urban house	13	*(14)*	97	*(17)*	103	*(16)*	107	*(22)*	0.86	*(4)*	304	*(10)*	1.0	*(19)*	4.4	*(20)*	98	*(20)*
Rural house	11	*(3)*	85	*(7)*	115	*(27)*	97	*(16)*	0.48	*(1)*	309	*(15)*	1.1	*(21)*	5.1	*(22)*	139	*(2)*
Middle-aged																		
Urban flat	12	*(4)*	81	*(3)*	105	*(21)*	77	*(7)*	1.12	*(17)*	289	*(2)*	0.9	*(17)*	4.2	*(17)*	99	*(18)*
Urban house	12	*(11)*	91	*(13)*	104	*(20)*	82	*(10)*	0.97	*(9)*	315	*(17)*	0.8	*(1)*	2.9	*(1)*	110	*(4)*
Rural house	14	*(19)*	98	*(18)*	102	*(14)*	114	*(24)*	0.93	*(8)*	322	*(21)*	0.8	*(4)*	3.1	*(3)*	100	*(16)*
Elderly																		
Urban flat	10	(2)	79	(2)	98	(9)	64	(2)	1.98	(27)	289	(3)	0.8	(6)	3.3	(6)	104	(6)
Urban house	12	(6)	90	(10)	108	(25)	92	(14)	0.97	(10)	300	(8)	0.9	(12)	3.6	(11)	100	(17)
Rural house	14	(23)	113	(26)	102	(13)	70	(4)	0.67	(2)	339	(25)	1.3	(27)	4.9	(21)	110	(3)

Note: Ranking in brackets

Source: Modelling results by M. Wier and L.B. Christoffersen, AKF, Institute of Local Government Studies.

Appendix to chapter 4 – distribution of CO2 emissions

Table A. Emission intensities domestic indirect CO2 Ton/MSEK 2000

	Text	co2tot	co2stat	co2mob
H01	Livsmedel	14.33	6.08	7.94
H02	Alkohol	5.98	3.11	2.70
H03	Tobak	2.45	0.84	1.53
H04	Klädesmatrl	4.16	1.07	2.92
H05	Kläder o rep	4.72	1.23	3.30
H06	Skor o rep	4.39	1.12	3.09
H07	Kallhyra	7.88	3.87	3.08
H08	Bostadsunderh	8.50	3.11	4.09
H09	Bostadsenergi	53.05	50.95	1.76
H10	Möbler o rep	6.80	2.43	3.81
H11	Mattor o textilier	4.62	1.39	3.05
H12	Hushållsapparater	3.77	1.10	2.44
H13	Husgeråd	8.53	3.97	3.63
H14	Verktyg	5.60	2.00	3.10
H15	Förbrukningsvaror	5.92	2.25	3.35
H16	Hushållstjänster	5.08	1.42	3.35
H17	Läkemedel	3.73	1.23	2.35
H18	Glasögon	6.41	1.65	4.49
H19	Sjukvård	4.05	1.97	1.93
H20	Bil, MC	4.20	1.63	2.18
H21	Cykel	3.99	1.25	2.46
H22	Reservdel fordon	4.86	1.70	2.83
H23	Drivmedel fordon	7.66	6.52	1.05
H24	Underhåll fordon	8.94	1.87	6.86
H25	Div fordonskostn	9.42	2.70	6.26
H26	Järnväg	23.57	5.19	18.11
H27	Buss, taxi, Kollektivtrafik	57.07	6.59	50.12
H28	Flyg	62.33	1.03	61.17
H29	Båt	122.39	2.10	120.14
H30	Post o Tele	12.05	1.19	10.68
H31	Tele, Audio, Video, IT	2.62	0.69	1.82
H32	Audio, Video, Itförbrukning	5.66	1.65	3.79
H33	Fritidsutrustning o rep	7.00	3.09	3.18
H34	Hobbyutrustning	4.25	1.14	2.92
H35	Växter	13.00	4.26	8.12
H36	Husdjur o vet	8.61	3.00	5.33
H37	Sport, Kultur, Spel	5.25	1.87	3.18
H38	Litteratur, Tryck o Pappersv	6.93	2.40	4.34
H39	Utbildning	1.16	0.56	0.57
H40	Restaurang	8.57	3.20	5.16
H41	Hotell	8.57	3.20	5.16
H42	Kroppsvård	5.70	1.83	3.42
H43	Varor för kroppsvård	6.46	2.24	3.97
H44	Personliga varor	5.57	1.60	3.66
H45	Omsorg	1.60	0.56	0.99
H46	Finansiell och övr tjänster	3.08	1.27	1.66

Table B. Estimated emission intensities for imports CO2 Ton/MSEK 2000

	Text	Co2tot	co2stat	co2mob	co2pro
H01	Livsmedel	16.51	7.33	8.30	0.87
H02	Alkohol	8.93	4.88	3.34	0.71
H03	Tobak	3.13	1.44	1.47	0.23
H04	Klädesmatrl	14.76	9.43	4.43	0.90
H05	Kläder o rep	10.95	6.18	4.04	0.73
H06	Skor o rep	13.15	7.15	5.12	0.89
H07	Kallhyra	2.65	1.45	0.73	0.47
H08	Bostadsunderh	12.60	6.73	4.07	1.80
H09	Bostadsenergi	8.77	5.78	2.48	0.50
H10	Möbler o rep	13.23	6.95	3.85	2.43
H11	Mattor o textilier	12.64	7.79	3.96	0.90
H12	Hushållsapparater	13.99	7.26	3.92	2.81
H13	Husgeråd	17.83	10.65	4.14	3.05
H14	Verktyg	13.96	7.28	3.76	2.93
H15	Förbrukningsvaror	13.19	7.58	4.18	1.43
H16	Hushållstjänster	5.87	2.58	2.65	0.64
H17	Läkemedel	8.50	4.75	3.08	0.66
H18	Glasögon	6.96	3.32	2.73	0.91
H19	Sjukvård	3.59	1.86	1.33	0.40
H20	Bil, MC	14.16	7.31	4.20	2.65
H21	Cykel	14.25	7.13	4.39	2.73
H22	Reservdel fordon	13.24	7.09	3.89	2.26
H23	Drivmedel fordon	19.36	11.67	6.79	0.91
H24	Underhåll fordon	7.35	3.67	2.73	0.94
H25	Div fordonskostn	5.98	2.78	2.41	0.78
H26	Järnväg	8.68	3.44	4.60	0.64
H27	Buss, taxi, Kollektivtrafik	16.44	6.49	8.99	0.95
H28	Flyg	49.82	7.38	41.57	0.87
H29	Båt	83.86	8.46	74.33	1.07
H30	Post o Tele	10.32	2.47	7.36	0.48
H31	Tele, Audio, Video, IT	11.55	5.47	4.47	1.61
H32	Audio, Video, Itförbrukning	8.90	4.46	3.22	1.22
H33	Fritidsutrustning o rep	13.51	7.11	3.79	2.61
H34	Hobbyutrustning	14.25	7.44	4.59	2.22
H35	Växter	19.55	8.35	9.99	1.21
H36	Husdjur o vet	19.21	9.49	8.58	1.14
H37	Sport, Kultur, Spel	3.88	1.78	1.70	0.40
H38	Litteratur, Tryck o Pappersv	6.34	3.03	2.77	0.54
H39	Utbildning	0.58	0.29	0.24	0.05
H40	Restaurang	7.55	3.09	3.97	0.49
H41	Hotell	7.55	3.09	3.97	0.49
H42	Kroppsvård	5.73	2.89	2.13	0.71
H43	Varor för kroppsvård	10.90	6.15	3.79	0.95
H44	Personliga varor	11.95	6.00	4.16	1.80
H45	Omsorg	0.68	0.32	0.30	0.06
H46	Finansiell och övr tjänster	2.61	1.19	1.17	0.25

Table C. Emissions of CO2 from Private Consumption 1993-2000 Kton

	1993	1994	1995	1996	1997	1998	1999	2000
Domestic indirect	13654	13967	13362	15997	12984	13353	12961	11391
In other countries	16025	16373	15801	18926	15616	16158	15703	14722
Direct emissions	15620	15993	16155	16283	15480	15181	15459	14525

Decomposition of indirect domestic emissions of CO2 1993-2000 – Yearly change

	1993	1994	1995	1996	1997	1998	1999	2000
Emission intensity		362	-598	2204	-2876	171	-995	-1575
IO structure		-169	-61	-6	-184	-155	77	-55
Volume FD		144	246	169	226	263	465	382
Structure FD		24	-134	58	-251	-36	-61	-322
Actual change		361	-547	2426	-3085	244	-513	-1570
	13654	13967	13362	15997	12984	13353	12961	11391

Table D. Domestic Indirect and Direct emission of CO2 per adult equivalent 2000

		Indirect			Direct
County	co2tot	co2stat	co2mob	co2pro	co2tot
Stockholm	1685	755	860	69	1497
Uppsala	1550	758	733	59	1923
Södermanland	1541	806	679	56	2345
Östergötland	1430	738	638	55	1812
Jönköping	1388	767	570	51	1971
Kronoberg	1430	776	599	56	2176
Kalmar	1386	779	557	50	2030
Gotland	1737	956	723	58	2428
Blekinge	1429	825	554	50	2041
Skåne	1490	781	653	56	1949
Halland	1530	815	659	57	2142
V Götaland	1447	760	631	56	2021
Värmland	1495	821	622	51	2318
Örebro	1427	778	598	52	2041
Västmanland	1587	802	728	56	2279
Dalarna	1377	741	587	49	1992
Gävleborg	1358	742	565	50	1824
Västernorrland	1421	797	574	50	2256
Jämtland	1553	833	667	52	2345
Västerbotten	1463	720	691	51	1902
Norrbotten	1478	778	647	53	2219
Household Type					
Single women no ch	1689	778	837	73	1311
Single men no ch	1823	861	888	74	2210
Single women w ch	1143	556	537	50	1059
Single men w ch	1408	719	631	58	1813
Cohab no ch	1781	933	784	64	2482
Cohab w ch	1279	681	552	46	1822
Others	1302	699	557	46	1831
Dwelling					
Agricult	1455	918	493	43	2526
Rental	1372	570	740	63	1233
Condo	1486	632	787	68	1499
House	1606	943	612	50	2521
Other	1373	577	746	51	1506
Income Decils					
D01	1353	595	705	53	884
D02	1559	760	736	63	1612
D03	1542	762	717	64	1712
D04	1572	785	724	64	1839
D05	1477	751	669	57	1851
D06	1417	732	632	53	1959
D07	1437	763	620	54	2021
D08	1438	769	618	51	2106
D09	1538	798	684	55	2130
D10	1684	877	744	62	2341

Tabel E. Estimated emission of CO2 in other countries per adult equivalent 2000 (Kg)

County	co2tot	co2stat	co2mob	co2pro
Stockholm	1381	655	600	126
Uppsala	1302	623	560	119
Södermanland	1278	630	531	118
Östergötland	1166	567	493	105
Jönköping	1172	581	481	110
Kronoberg	1249	618	510	121
Kalmar	1125	554	469	101
Gotland	1374	648	599	127
Blekinge	1204	600	486	118
Skåne	1236	603	521	112
Halland	1273	613	545	115
V Götaland	1205	591	503	111
Värmland	1202	582	513	107
Örebro	1142	559	481	102
Västmanland	1358	643	596	119
Dalarna	1152	562	485	105
Gävleborg	1161	568	486	107
Västernorrland	1183	582	495	105
Jämtland	1277	617	552	108
Västerbotten	1244	583	550	111
Norrbotten	1267	607	547	112
Household Type				
Single women no ch	1309	623	571	116
Single men no ch	1509	711	660	138
Single women w ch	869	414	380	75
Single men w ch	1105	542	460	103
Cohab no ch	1491	725	630	136
Cohab w ch	1095	536	458	101
Others	1063	518	449	95
Dwelling				
Agricult	1119	560	457	102
Rental	1177	553	518	106
Condo	1328	630	576	122
House	1282	635	529	117
Other	1231	574	550	107
Income Decils				
D01	1013	464	466	83
D02	1144	542	508	95
D03	1271	615	538	119
D04	1264	608	541	114
D05	1195	575	513	107
D06	1171	565	503	104
D07	1194	585	498	110
D08	1232	604	514	114
D09	1321	639	560	122
D10	1483	729	614	141

Appendix to chapter 5 – decomposition

CO2 decomposition 1993-2000

Diagram A. Total CO2 emissions, 1993-1999

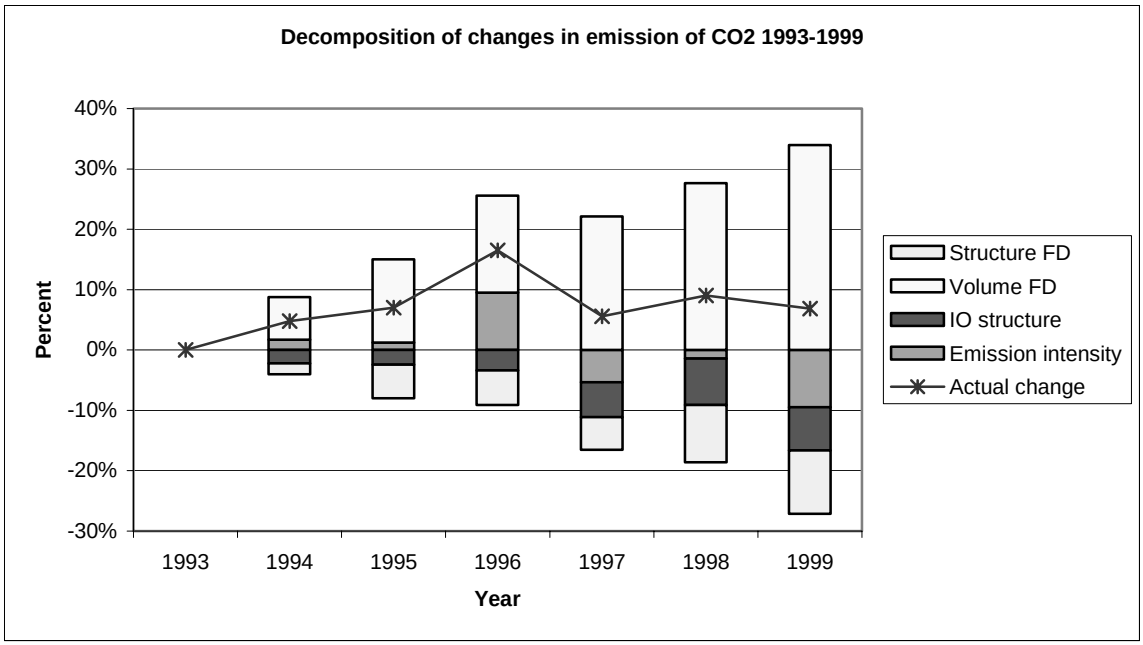
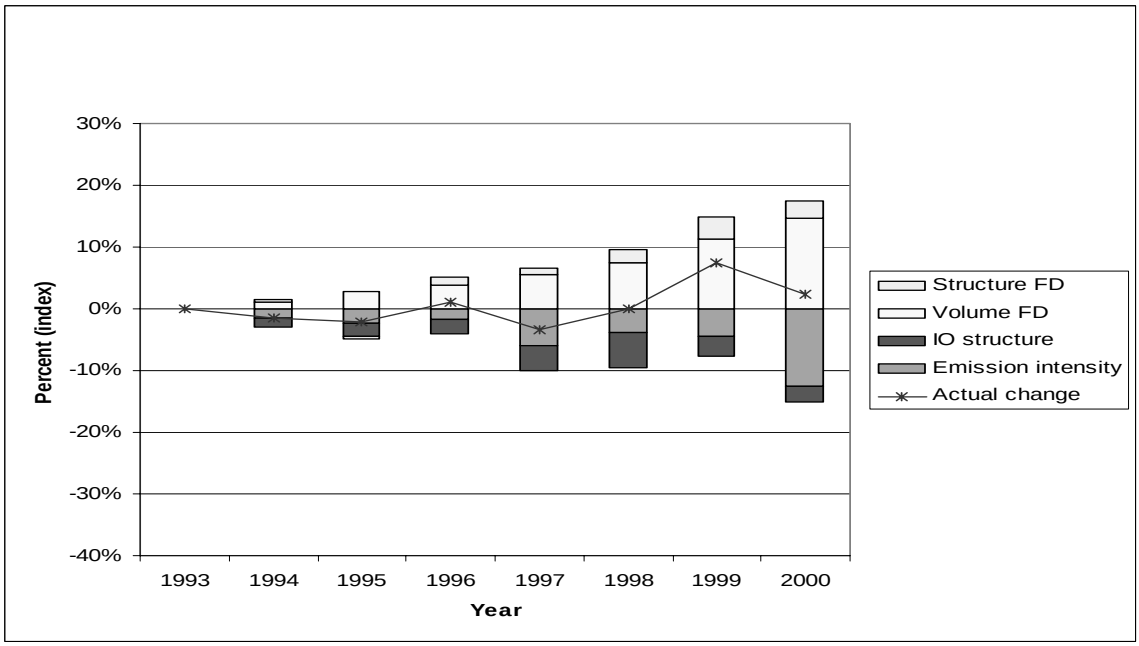


Diagram B. Indirect domestic CO2 emissions (mobile sources), 1993-2000.



Decomposition indirect and international CO2 in 2000

Diagram C. Domestic mobile CO2 per adult equivalent, 2000 – household type etc.

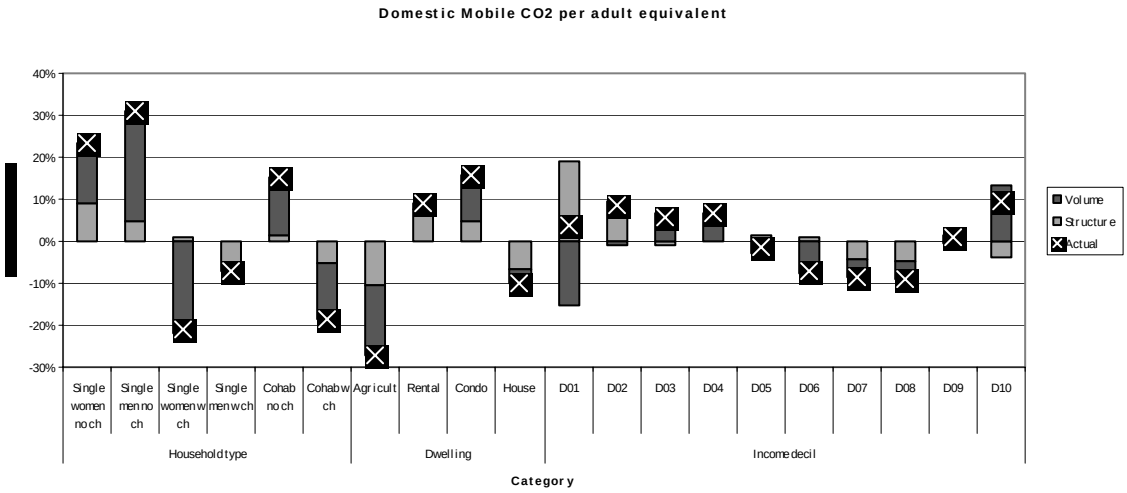


Diagram D. Domestic mobile CO2 per adult equivalent, 2000 - counties

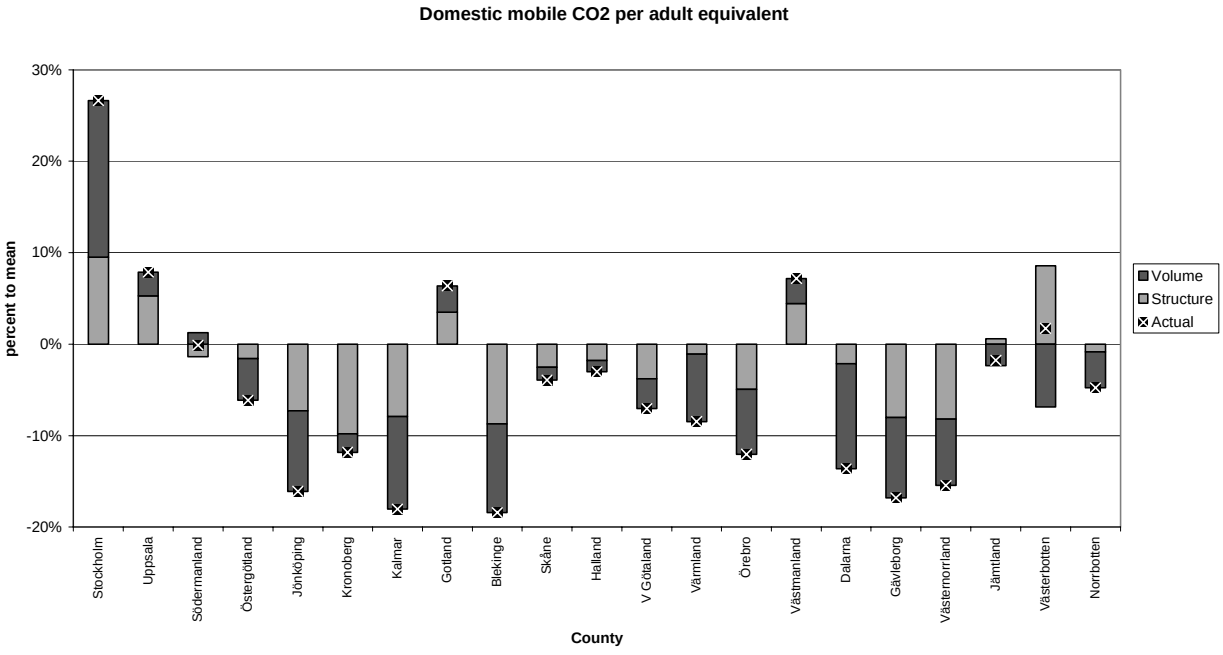


Diagram E. Domestic stationary CO2 per adult equivalent, 2000 – household type etc.

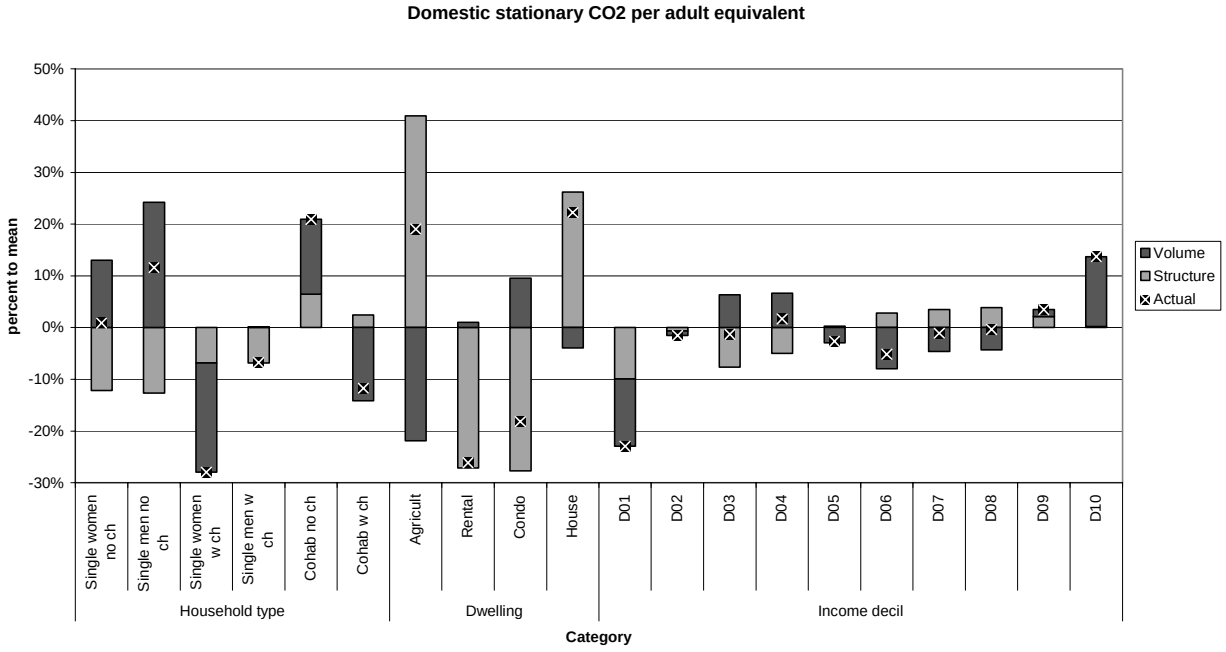


Diagram F. Domestic stationary CO2 per adult equivalent, 2000 - counties

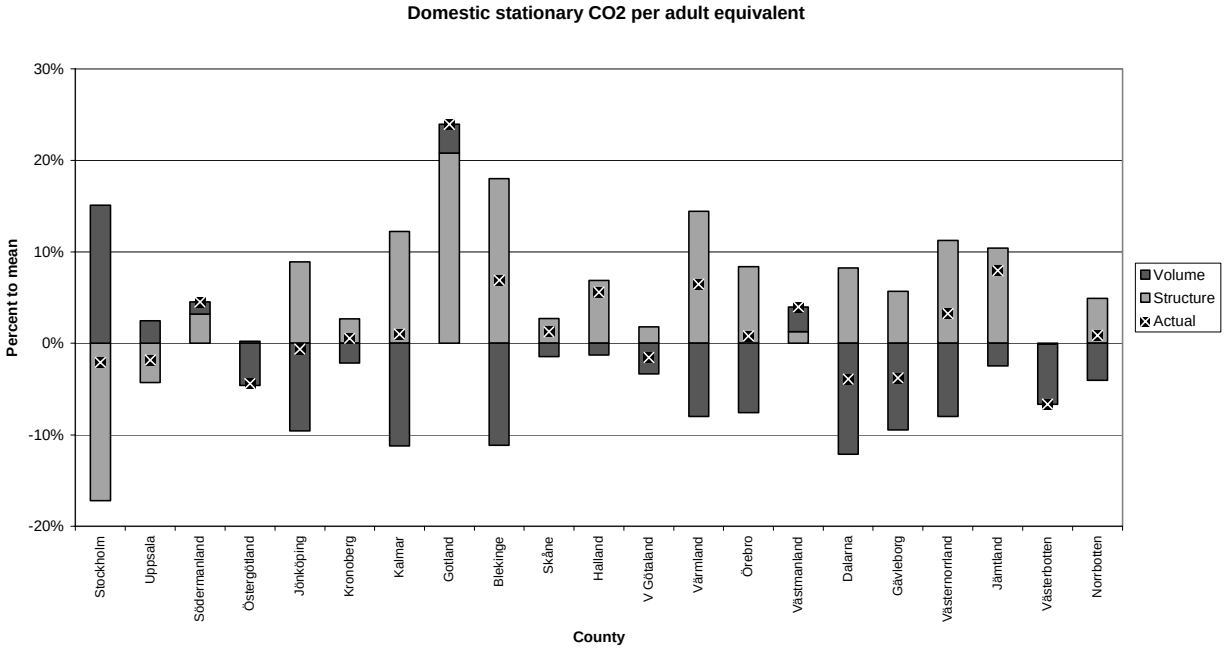


Diagram G. CO2 emission in other countries per adult equivalent, household type etc.

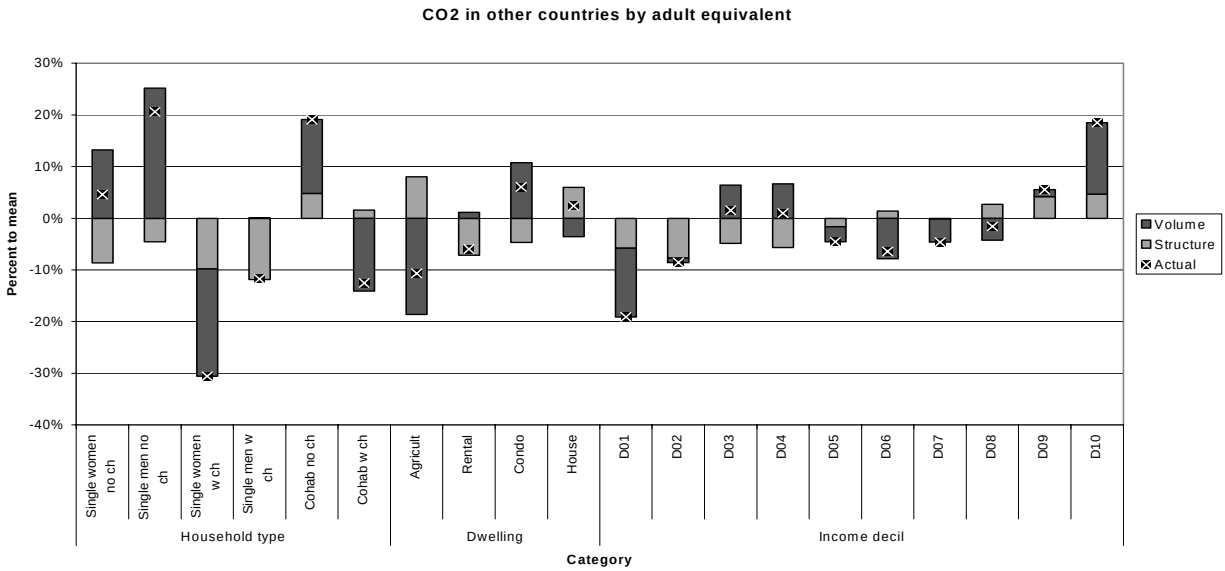


Diagram H. CO2 emission in other countries per adult equivalent - counties