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Environmental Goods and Services Sector in Sweden - suppliers

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Preface

This report has been prepared on commission and with financial support from Eurostat (EU Grant Agreement 50304.2008.001-2008.340), which assists and coordinates the development of environmental statistics in the EU Member States. The purpose of this project has been to search into methods to be able to estimate the size of the suppliers to the production in the Environmental goods and services sector (EGSS). Mats Eberhardson and Anders Wadeskog have carried out the work and are responsible for the contents of the report.

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 and maintain a system of physical accounts that are linked to the production and consumption activities described in the National accounts. In practice, this means developing and maintaining a system of environmental and natural resource statistics linked to the industry, product and sector categories used in the National accounts, thus forming a satellite system of accounts around the National accounts.

According to the UN, a system of Environmental accounts should in principle cover[1]:

• Flows of materials through the economy, e.g. energy and chemicals, together with the emissions and waste to which these flows give rise. Within the EU, many countries have opted to use the NAMEA system[2] to describe these flows.
• Economic variables that are already included in the National accounts but are of obvious environmental interest, such as investments and expenditure in the area of environmental protection, environment-related taxes and subsidies and environmental classification of activities and the employment associated with them.
• Natural resources: Environmental accounts should make it possible to describe stocks and changes in stocks of selected finite or renewable resources. Environmental accounts should deal both with questions related to the monetary valuation of this natural capital and qualitative aspects that do not have any market or other defined monetary value, e.g. the value of outdoor life and biodiversity.

Statistics Sweden, January 2010

[1] UN, 2003
[2] NAMEA stands for National Accounting Matrix including Environmental Accounts. In principle this is a Social Accounting Matrix (SAM) supplemented by Environmental accounts data on, e.g., emissions to air and waste, linked to the Use and Supply Matrices that a SAM is constructed around. Just as a SAM is a way of presenting National accounts data, NAMEA is a way of presenting Environmental accounts data.

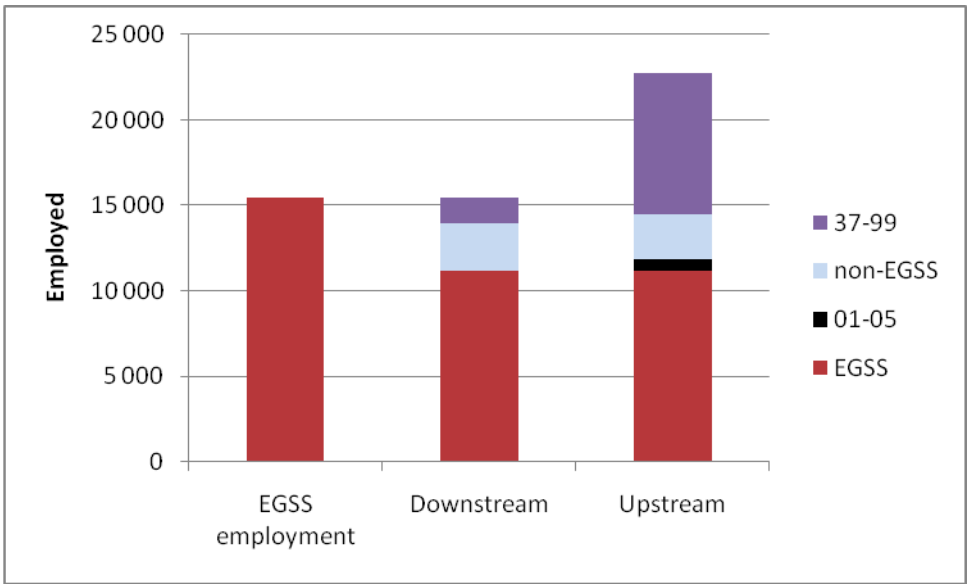
Summary

Statistics Sweden (SCB) started out the work in the field of environmental goods and services sector (EGSS) in the late 1990's. Except for a few years SCB has worked continuously with the area, refining the methods and practices of the statistics. The work has until recently been entirely focused on the EGSS as main producers of environmental goods and services, disregarding the rest of the value chain leading up to the final goods and services. Since stakeholders and users of this statistics have expressed interest in the supply chain in, or the upstream effects of the production from the EGSS, SCB decided to explore the possibilities to form methods to measure the size of the EGSS' suppliers.

In this project, prepared on commission and with financial support from Eurostat, SCB has aimed to search into methods and made an attempt to estimate the size of suppliers to the EGSS. The approach chosen was to start with an ordinary use table from the Swedish National accounts and split this table into two layers, one for the EGSS and one for the non-EGSS. To construct the EGSS use table we have also taken advantage of the survey on industrial use of purchased goods to be in accordance with the data used by National accounts to construct use tables. The resulting use tables have then been the foundation for the input-output analyses made in the project.

The results show that the approaches of the project were fruitful, even though they are in need of further refining to perform an analysis in full conformity with the total use table from the National accounts. Some bold assumptions were necessary to fill the gaps of data needed to be able to perform the analyses. To fill the data gaps, especially in terms of the services industries, and to learn the finer details in the methodologies of constructing use tables, closer cooperation with the National accounts have to be developed.

Apart from the assumptions made in the project, the results from the analyses are interesting and they demonstrate differences between the EGSS and the non-EGSS, both in terms of input structure and employment and CO2 intensities. In so far the assumptions made are reasonably fair, there are indications that the EGSS are less intensive in terms of employment and CO2 emissions, which in turn might be a sign of a different production mix in comparison to the non-EGSS.



Employment due to EGSS production.

Finally, as shown in the diagram above, the estimation of the size of the suppliers to the EGSS show that for each employed in the actual EGSS production, roughly one more is employed at the supplier level.

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1 Introduction

1.1 Background

The first attempt to produce statistics on the Environmental Goods and Services Sector (hereafter referred to as EGSS) in Sweden started in 1998 by compiling a first list of enterprises and establishments with activities defined as environment industry according to the manual published by OECD/Eurostat in 1999. The early work focused mainly on data for the "core industries" (NACE 25.12 *Retreading and rebuilding of rubber tyres*, 37 *Recycling*, 41 *Collection, purification and distribution of water*, 51.57 *Wholesale of waste and scrap*, and 90 *Sewage and refuse disposal, sanitation*, (NACE rev 1.1)) collected from registers. Later projects have focused on improving data quality and to increase the coverage of establishments in the list, which has been developed as a database.

Between 2000 and 2003 the work with the Swedish EGSS database was put on hold due to a lack of resources. In 2004 and 2005 the work was initiated again. The main output of the work carried out since 2003 is a yearly updated database of Swedish EGSS-establishments and an IT-application which makes the update and finding of new environmental establishments easier. Work has also focused on finding new environmental establishments that started or changed between 2000 and 2003, in order to update the database. Another change is that today, the database is based on environmental establishments instead of enterprises, which enables better precision and therefore more reliable statistics[3]. During 2006 and 2007, a thorough quality enhancement work was performed and the database was revised. A small but still significant change was introduced to the IT-application; it has been made possible to add an "environmental share" to the establishments belonging to the secondary sector[4]. By adding an "environmental share" the over-estimation of the total Swedish environmental sector has decreased.

The system boundaries of the EGSS have been in focus for discussion during the last years, at SCB as well as within the Task Force of Eurostat. It is quite clear that producers of environmental goods and services are to be included whereas suppliers to the establishments within the EGSS and distributors of the same goods and services are more in doubt and has been excluded from the current definition of EGSS[5]. In any case, stakeholders and users tend to be interested in information on both suppliers to the actual producers, as well as the distributors, of environmental goods. The questions posed range from the size of employment of the upstream effects of the EGSS, to the volume shares between bio fuel and "ordinary" fuel at a distribution level.

During the last years, the EGSS in Sweden and in the rest of the world has received more and more public interest. One reason has been the predicted economic growth in the area and therefore the need of reliable information is large for the sector. However, in order to be able to produce good data on regular basis, the area of EGSS still requires further methodological work. In order to improve the quality of statistics the system boundaries need to be defined. As mentioned above, stakeholders and users do want information on suppliers to the sector which at this time is not possible to include in the database. Statistics Sweden has during the years of work with the environmental sector noted areas to improve and develop. Due to the experience and knowledge which now exist within Statistics Sweden further steps can be taken to improve methods to estimate the size of the total EGSS and its upstream effects.

[3] For reports on this work see SCB, 2005:2 and SCB, 2006.
[4] By "secondary sector" we mean establishments with different types of activities. Some of the activities can be environmentally related and some of them not. The "environmental share" tries to capture the environmentally related activities carried out at the specific establishment.
[5] Eurostat, 2009

1.2 Purpose

The purpose of this project is to search into methods and make an attempt to estimate the size of suppliers to the EGSS.

1.3 Limitations

The main source of information in this project has been the statistics on intermediate goods, namely the survey on "Industrial use of purchased goods" which, obviously, focuses on the use of goods in the mining and quarrying and manufacturing industry, i.e. NACE 10-36 (rev. 1.1). The implication of this is that we only have access to the specific input *goods* and not the input *services* needed to produce goods. This has led to that we have only had possibility to construct structures for the use tables for NACE 10-36, as shown in table 1.

Table 1. Structuring of data in the EGSS use tables.

	Industries (NACE)	10	13	14	15	- -	- -	36
Products (CPA)								
10								
13								
14								
15								
- -								
- -								
36								

To be able to perform the input-output analysis there has to be complete and symmetric data sets for both the EGSS and the non-EGSS. We have therefore assumed that the structure for the EGSS in the industries in NACE (rev. 1.1) 01-05 and 37-99 is the same as for the total economy (i.e. we have used the structure from the use tables derived from the Swedish National accounts). This assumption reduces the validity of our analysis but to produce a complete use table for the EGSS exceeds the resources in this project.

In the application for this project three approaches were proposed to be able to estimate the size of the suppliers to the EGSS. One of these three approaches concerns a selection of goods drawn from the WTO-list[6] of supposed environmental goods. This list contains around 100 goods labelled with Harmonised System (HS) codes (up to six digit level equal to the Combined Nomenclature (CN) codes) which are thought to some extent be environmentally related. This also means that the WTO-list is a subset of the total goods being produced by the EGSS as is shown in an earlier report[7]. During the analysis of the material it was clear that this approach was not going to give any useful results due to the fact that it is a subset of the total goods production. The results that could have been shown are also evident in the analysis of the complete set of goods. Besides this, the value of Swedish production of the specific goods included in the WTO-list is too small to be published due to confidentiality. Due to these reasons we decided to terminate the work with this approach and instead focus on the other two approaches which are dealt with in the following chapter.

[6] OECD, 2005.
[7] SCB, 2006, see chapter 7 "The environmental sector from a product perspective".

2 Method

The aim of this project was to search into methods to make an estimation of the upstream effects from the production of environmental goods and services (e.g. the suppliers to the EGSS). To be able to do so, three different approaches were proposed:

1. By using statistics on intermediate goods for the goods produced by the establishments included in the Swedish EGSS database.
2. By using statistics on intermediate goods for a selection of the environmental goods that are included in the WTO-list[8].
3. By applying an input-output analysis of the EGSS establishments.

As mentioned earlier in chapter 1.3, the second approach was abandoned early in the process and the focus was on the other two approaches.

The first approach was necessary in order to construct use tables, which in turn is a prerequisite to perform the input-output analysis. In the first step we can show from where the input goods come to the EGSS but it is only through the last step that it is possible to estimate the upstream effects of the production from the EGSS. Below we describe the sources and the steps taken from raw data to the estimations of the suppliers to the EGSS.

2.1 Data sources and methodological approach

To construct a use table for the EGSS we have used statistics on intermediate goods retrieved from the survey on "Industrial use of purchased goods" (abbreviated INFI) for the years 2003-2005. The survey has been carried out every year since 1999 by Statistic Sweden (SCB). INFI is also the main source for the National accounts to build supply and use tables. The survey is sent out to all enterprises in NACE 10-36 (rev. 1.1) with 50 or more employees[9]. Not all industries are included every year but instead a rolling schedule has been implemented where one-third of NACE 10-36 is surveyed each year. This means that to have a complete data set for NACE 10-36, data from three different years have to be used. In this project we have used data for 2003-2005 to achieve a complete coverage of the industries within NACE 10-36.

The INFI-survey collects the total value of the use of goods by each industry for Swedish industrial production during one year. The collected data is compiled in groups of goods based on the Combined Nomenclature (CN), mostly on a four-digit level but in especially important groups of goods up to the CN eight-digit level.[10]

The other main data source is the statistics on EGSS that SCB have compiled regularly since 2003[11], according to internationally agreed guiding principles[12]. In this project we have used the compiled population of EGSS establishments for year 2005. In order to perform the first step of our approach and construct the EGSS use tables, we have linked the existing Swedish EGSS population to the data from INFI and hence retrieved information on the used input goods for industrial production within the EGSS.

[8] OECD, 2005.
[9] For 2003 and 2004, the sampling method was changed for 2005, see below in chapter 2.2.
[10] SCB, 2007.
[11] For a comprehensive discussion on methodological issues within the area of the Swedish EGSS population, see SCB, 2006.
[12] OECD/Eurostat, 1999 and Eurostat, 2009.

The data from this first step consisted of the value of the products (grouped by CN codes) purchased by each industry group (NACE 10-36, rev. 1.1, two-digit level). In the steps thereafter, we have used cross classification tables to transform the CN codes into CPA codes[13] (Classification of Products by Activity) in order to construct a use table symmetric to the use table for the total economy. As mentioned above, this step was only possible for the industries in NACE 10-36 as well as products in CPA 10-36.

For the industries outside of NACE 10-36 we have used a somewhat different method to estimate the value of input and their use structure. Since it is possible to calculate EGSS' production value and value added, we simply subtracted each industry's value added from their production value and thereby had an estimate of the input value for each industry. We then assumed that the EGSS part of each industry had the same structure of use as the total of that specific industry and hence distributed the input value accordingly. The result of the two methods of estimating the input for the EGSS is a table symmetric to the ordinary use table for the total economy with industries (NACE) as the column and products (CPA) as rows.

Out of this table it is then possible to split the original total economy use table. Basically, we deducted the EGSS values from the total economy table and thus constructed one EGSS use table and one non-EGSS table.

2.1.1 The basic idea

The Environmental accounts in most European countries aim at producing a physical description of the environmental pressures from all economic activities in a given year. This means that the volume of emissions etc produced is directly related to what is produced in the national economy, i.e. it is the physical mirror image of GDP.

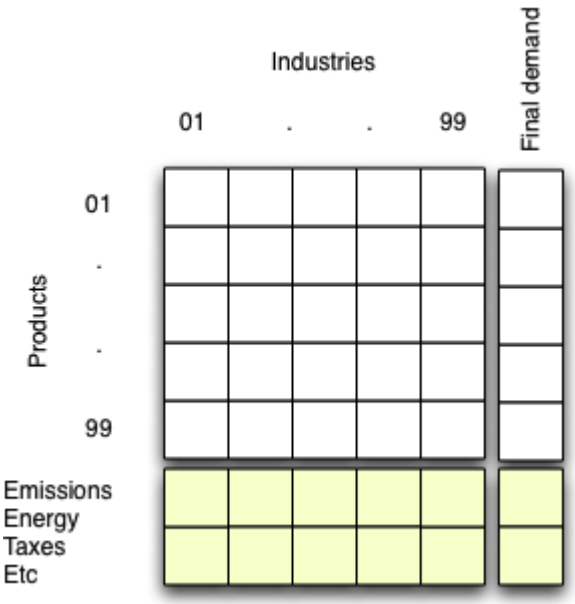

Figure 1. The Use table and the Environmental accounts

The links between economic activity and environmental pressure is by industry for the production side of the economy. Added to this are the environmental pressures caused by private and public consumers, e.g. burning fuels and creating waste. The Environmental accounts parts are the coloured matrices below the Use matrices (that include Final demand), see figure 1.

[13] CN 2005 – CPA 2002

All links between the economy and the environment are not physical. There are parts of the monetary accounts that are interesting from an environmental point of view. Energy- and CO2-taxes are examples of this as well as environmental expenditures and investments. In this project we focus on the EGSS, which is already included in the Use table above.

The idea with this project is therefore to single out the part of the input structure, i.e. the product purchased as intermediary inputs by the industries in the use matrix above, that can be labelled as belonging to the EGSS. In principle, we would like to analyse the EGSS as a separate economy within the ordinary economy, i.e. creating an extra environmental layer in the Use and Environmental accounts matrices.

In figure 2 below, these layers are illustrated side by side instead of on top of each other.

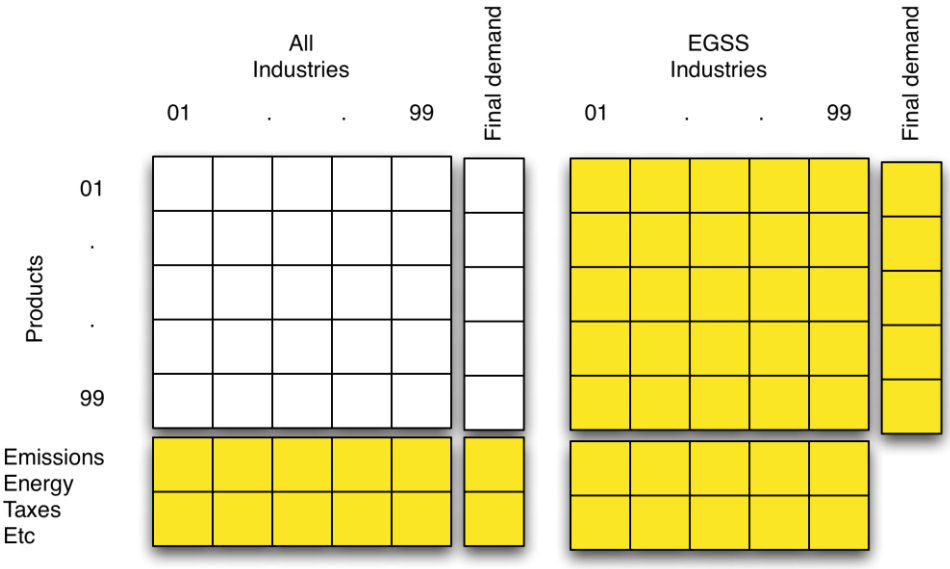

Figure 2. The separation of EGSS use table.

It is important to try to develop the monetary statistical side of the Environmental accounts further as environmental production and consumption is expanding in most industries and product groups. As the National accounts, and therefore the Environmental accounts, publish averages for the whole economy, industries and products, structural changes are hard to separate from changes over the business cycle or droughts and cold winters.

Ideally the data in the Environmental accounts should cover also changes within industries and product groups, e.g. show the distribution around the mean. In this report we look at the differences between EGSS and the rest of the industry for a subset of industries. In the future we hope to be able to take this further.

2.1.2 IO-data used for the analysis

When constructing the EGSS input tables we used the most detailed data from the official 2005 Input-Output tables for Sweden[14]. Symmetric IO-tables are only produced every 5 years in accordance with the requirements from Eurostat.

The most detailed data is roughly 135 industries that, together with imported products, create a supply of 400 products that are used in 135 industries and the components of Final Demand. These 400 products can be valued in everything from basic or domestic producers, prices to purchasers' prices including import, trade margins, taxes and subsidies.

[14]See http://www.scb.se/Pages/ProductTables____11040.aspx for a 2-digit version of the 2005 IO-tables.

Although we have used same input surveys that are used by the National accounts, ours will most likely deviate from the official ones. It has not been possible to do more in the timeframe of this project.

2.1.3 Converting the input tables

The official IO-tables, i.e. supply and use tables as well as the symmetric IO tables, do not distinguish the EGSS from other establishments in the respective industries. We have used the industry inputs surveys to try to map the input structures of the EGSS and then use this to derive the input structures for the rest of the industries in NACE 10-36 (rev 1.1).

This split is illustrated in figure 3 below.

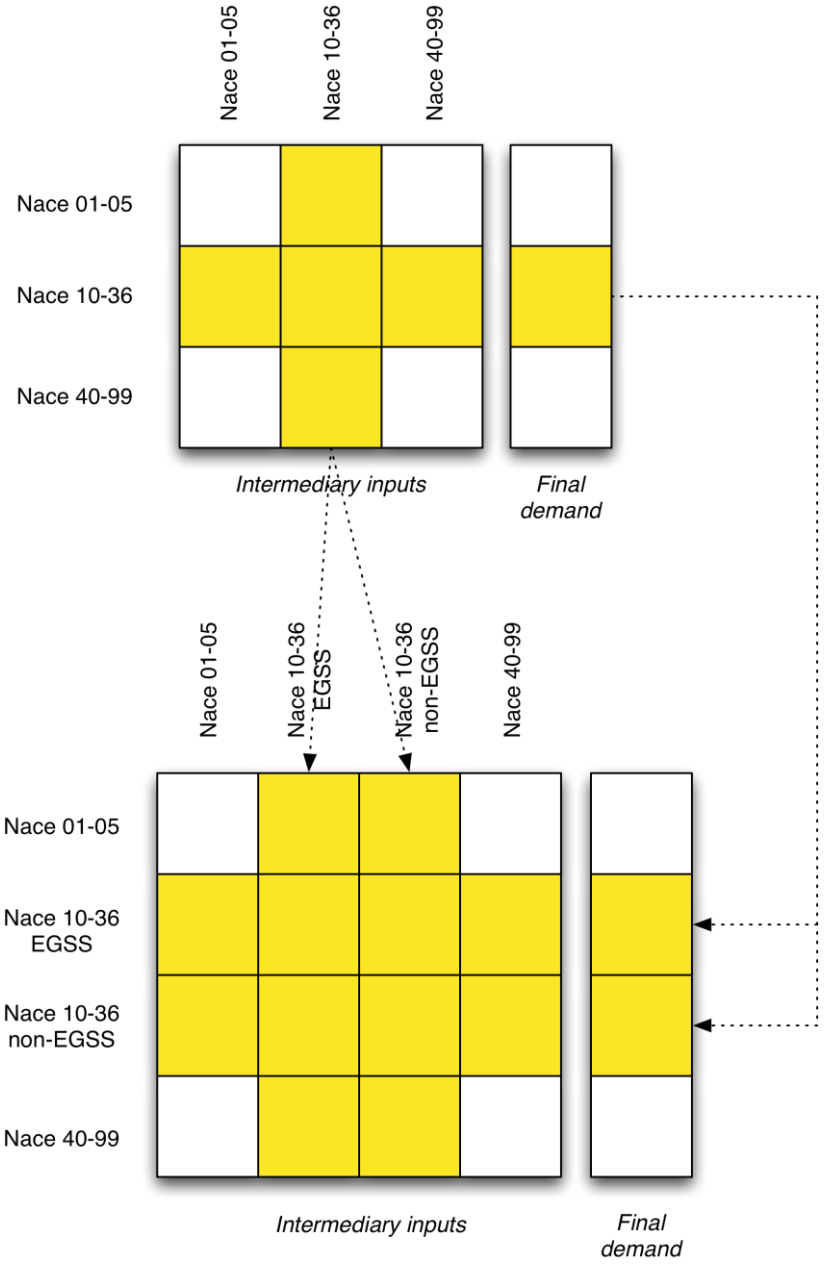

Figure 3. The conversion of the input table.

In Sweden, a two digit NACE IO table would encompass roughly 50 industries or products. The input survey covers half of these, i.e. 25 industries.

We made a new Use table consisting of 25 industries for EGSS and 25 for the rest of NACE 10-36 (non-EGSS). This had to be done both for the columns and for the rows, producing a table for intermediary inputs with the dimension 80 x 80. The final demand matrix was also expanded to 80 rows.

The two columns in the input matrix were constructed from the input survey and balanced against the official input table from the 2005 IO tables. A few simplified assumptions were employed to be able to go from the allocation in purchasers' prices to the domestic basic prices used in the Use table of the IO tables.

The rows were split according to production values in the industries in the EGSS and the residually calculated production values in the industries in the non-EGSS.

The distribution between the EGSS and the non-EGSS NACE 10-36, in the columns, was done using the Product x Industry Input and Use tables. The resulting table was then transformed into a industry x industry table before the distribution over the rows was made.

2.1.4 The Input Output Analysis

We did a fairly standard IO analysis for employment and emissions of CO2. The model can be described in the following way, using the CO2 version.

Emission of CO2= $e(I-A)^{-1}FD$

where:

$e=\begin{bmatrix} e_{1:5} & e_{EGSS} & e_{nonEGSS} & e_{40:99} \end{bmatrix}$ for 3, 25, 25 and 27 industries

and

$e_{1:5}$= Ton emission of CO2 per 1 million SEK (MSEK) produced in industries NACE 01-05

$$A=\begin{bmatrix} A_{1:5}^{1:5} & A_{1:5}^{EGSS} & A_{1:5}^{nonEGSS} & A_{1:5}^{40:99} \\ A_{EGSS}^{1:5} & A_{EGSS}^{EGSS} & A_{EGSS}^{nonEGSS} & A_{EGSS}^{40:99} \\ A_{nonEGSS}^{1:5} & A_{nonEGSS}^{EGSS} & A_{nonEGSS}^{nonEGSS} & A_{nonEGSS}^{40:99} \\ A_{40:99}^{1:5} & A_{40:99}^{EGSS} & A_{40:99}^{nonEGSS} & A_{40:99}^{40:99} \end{bmatrix}$$ for 80 by 80 industries

and

$A_{1:5}^{EGSS}$= Intermediary inputs of industries NACE 01-05 output per MSEK produced in the industries in EGSS

$$FD=\begin{bmatrix} FD_{1:5} \\ FD_{EGSS} \\ FD_{nonEGSS} \\ FD_{40:99} \end{bmatrix}$$ for 3, 25, 25 and 27 industry outputs

and

FD_{EGSS}= MSEK Final demand for output from industries in EGSS

The analysis is all in terms of domestic effects although effects in other countries through trade would have been possible to add. However, we felt that this would be stretching the underlying data too far.

The analysis was done in two ways. One is a simple upstream analysis looking at 1 MSEK of final demand for each industry output. It's basically a multiplier analysis on the margin showing the effect of the distribution of inputs or intermediary input suppliers.

The other type of analysis uses the structure of final demand (or output) to allocate 1 MSEK over the industries comprising the EGSS and the non-EGSS. This is a weighted analysis over the whole group.

2.2 Data quality and data confidentiality

The INFI survey for 2003-2004 employed a sampling method which meant that all enterprises with 50 employees or more was surveyed. The implication of this method was that some industries had a coverage degree of nearly 100 % while some other only had around 30 %. The survey design was changed before the survey of reference year 2005 where the coverage degree should be at least 70 % in all industries. The degree of coverage depends on to which amount the specific industry could be regarded as homogenous or not. If the industry is homogenous, the sample can be decreased, if not the sample will be increased. The objective of this sample design is a good quality over all surveyed industries.

When it comes to quality issues in the EGSS population it is hard to give any exact figure of the quality and coverage. This is because of a few reasons. Firstly, it is difficult to know how large "the universe" is concerning environmental activities which can take place within specialised producers, as a secondary activity or simply as a mean to produce goods and services in a more environmentally friendly manner. Secondly, even if the coverage in terms of establishments was complete it is not possible to give the exact estimate of the output from the establishment outside of the specialised producers. In order to deal with these difficulties within the area, SCB have worked continuously to improve the methodologies in the EGSS area. The most important step is the implementation of "environmental shares". These shares are given to each (first and foremost) large establishment that have a diverse production, i.e. the establishment is not fully involved in environmental activities. By this share only a part of the establishment's output are calculated for and not the total output. In this way an overestimation of the EGSS is avoided.

Due to confidentiality reasons, INFI is not published but only used by the Swedish National accounts as working material to construct supply and use tables. As a result we cannot publish values in most of the tables below. Instead, when showing the EGSS use table and comparing the input structures between the EGSS and the total economy we show the actual percentage distribution within each industry group. The comparison of the two structures can still be made as is shown in the next chapter.

3. EGSS in Sweden and its suppliers

3.1 Use tables as a tool to estimate the suppliers to EGSS

In this part of the report we present the construction of use tables as the first step to estimate the upstream effects of the EGSS production. We start out from the use table of the total economy and then we present the split into the EGSS and the non-EGSS use tables. As mentioned earlier, by reasons of confidentiality the tables are expressed as the distribution of percentage instead of actual values.

3.1.1 Use table and input structure in the total economy

Below, in table 2, we show the structure of the partial (NACE 10-36, CPA 10-36) use table in the total economy as is used in the input-output analysis (IOA) in the following subchapter. In the use table it is shown where the input goods, in this case expressed as CPA products, come from and who the user is in terms of which industry. For example, 47.8 % of the input goods to the Mining and quarrying industry (NACE 13-14) come from "Machinery and equipment products" (CPA 29).

Table 2. Use structure in the total economy, 2005 (NACE 10-36, CPA 10-36)

Industry (NACE) / Products (CPA)	10-12	13-14	15-16	17-19	20	21-22	23-24	25	26	27	28	29	30-32	33	34	35-36
10-12	28,6%	2,1%				0,1%	56,0%		1,7%	2,9%						0,2%
13-14	6,0%	20,4%	0,1%			1,7%	0,4%	0,3%	13,0%	20,0%	0,3%	0,1%				
15-16			69,6%	4,0%		1,2%	1,3%	0,2%								0,1%
17-19		0,4%	0,1%	48,6%	0,3%	1,5%		1,2%	2,6%	0,1%	0,6%	0,7%		0,3%	0,4%	3,5%
20	36,9%	0,7%	0,4%	0,4%	62,3%	6,9%		0,7%	2,0%	0,3%	1,4%	0,8%	0,6%	0,7%	0,2%	9,5%
21-22		1,0%	9,1%	2,2%	3,0%	61,6%	1,1%	3,8%	5,3%	1,0%	1,6%	2,0%	3,7%	2,4%	0,8%	1,8%
23-24	12,9%	13,8%	5,3%	28,8%	7,1%	16,6%	35,7%	61,1%	21,9%	6,3%	4,7%	2,2%	2,5%	2,9%	1,6%	5,1%
25	8,3%	1,1%	7,7%	3,2%	3,3%	2,6%	2,0%	16,0%	4,7%	0,4%	2,0%	4,2%	2,5%	6,1%	5,3%	4,5%
26		3,9%	1,7%	2,4%	4,1%	0,2%	0,4%	0,8%	31,3%	1,1%	1,9%	0,6%	0,3%	2,8%	1,2%	1,0%
27		0,3%		3,9%	1,7%	0,9%	0,4%	5,3%	8,1%	61,8%	40,6%	14,3%	12,8%	9,2%	6,9%	12,5%
28		6,4%	3,9%	0,6%	12,4%	0,5%	0,7%	3,6%	6,1%	3,6%	35,6%	21,4%	4,1%	8,0%	8,0%	10,4%
29	6,2%	47,8%	1,5%	3,3%	4,4%	5,4%	1,3%	4,5%	1,9%	1,8%	4,8%	36,4%	1,8%	6,7%	6,1%	5,4%
30-32	1,2%	1,1%	0,3%	0,6%	0,8%	0,7%	0,5%	2,3%	0,6%	0,6%	3,9%	11,3%	70,3%	29,7%	2,8%	4,9%
33							0,1%				0,3%	1,1%	0,6%	31,0%	0,1%	0,9%
34		0,6%									0,9%	4,2%			63,3%	1,0%
35-36		0,5%		2,1%	0,7%				0,6%	0,3%	1,3%	0,7%	0,8%	0,2%	3,2%	39,2%

As can be seen in table 2, a large portion of the input in each industry is taken from "itself" (marked with a dotted line in the table), in many cases even the largest part. The rest of the input goods are purchased from other industries (expressed here as products). Out of this use table for the total economy we have split it into two use tables, one for the EGSS and one for the non-EGSS. The structures of the two sets are presented below.

3.1.2 The EGSS and non-EGSS use tables

Below, in table 3 and table 4, the use tables/input structure for the EGSS and non-EGSS is shown. The two use tables sum up to NACE 10-36 in the total economy.

In table 3, use table of the EGSS, it is evident that it in some parts differs from the structure of the total economy. The industries' use of their own products as a large part of their input goods (the dotted line) is still common in most cases but the structure of EGSS input goods in the separate industries diverge from the use in the total economy. In line with the example for the total economy, the largest input

product group in the Mining and quarrying industry (NACE 13-14) is the other Non-metallic mineral group (CPA 26) with a share of 61.4 % where this product group in the total economy stands for a mere 3.9 %. It is also apparent that there are fewer input products groups represented in the EGSS.

Table 3. Use structure in the EGSS, 2005 (NACE 10-36, CPA 10-36)

Industry (NACE) / Products (CPA)	10-12	13-14	15-16	17-19	20	21-22	23-24	25	26	27	28	29	30-32	33	34	35-36
10-12	40,0%	2,9%					30,5%		0,2%	0,2%						
13-14	8,1%	9,8%	0,2%			5,0%	1,6%	1,6%	8,8%	5,2%	0,2%	0,1%				
15-16			85,4%	0,5%		1,8%	2,5%		1,7%							
17-19				32,1%		2,6%		1,2%	0,3%		0,5%	0,2%		0,3%		2,4%
20	48,3%		0,6%		97,3%	28,1%			2,4%		0,2%	0,1%				58,1%
21-22			4,0%			40,9%		0,4%				0,3%	0,3%	0,6%		1,6%
23-24	3,1%	7,8%	4,1%	65,8%	0,6%	17,2%	60,3%	41,8%	8,9%	5,2%	1,9%	2,3%	0,9%	1,3%	30,4%	3,5%
25	0,6%	0,6%	4,7%	0,5%	0,4%	1,0%	1,2%	35,1%	3,8%	0,7%	1,4%	2,2%	2,1%	1,5%		4,7%
26		61,4%		0,2%	0,3%	0,3%	1,7%	0,6%	57,0%	1,2%	2,0%	1,7%	0,3%	0,1%		0,8%
27				0,2%		0,3%	1,2%	5,2%	10,6%	81,9%	67,1%	26,6%	12,4%	3,3%	69,5%	9,7%
28		1,8%	1,0%	0,7%	0,6%	0,2%		3,5%	6,0%	0,6%	7,9%	14,5%	3,3%	5,1%		15,7%
29		14,1%			0,6%	2,4%	0,8%	6,4%	0,2%	0,4%	12,1%	22,7%	7,5%	11,7%		
30-32		0,6%				0,2%		4,1%		4,5%	5,7%	28,9%	72,6%	67,9%		
33											0,8%	0,2%	0,7%	8,2%		
34		1,1%									0,1%	0,1%				
35-36																3,4%

Below the structure of the non-EGSS' part of the industries is shown, see table 4. As mentioned above, this is basically a deduction of the EGSS input from the input to the total economy resulting in a subset non-EGSS use table. For obvious reasons, the use structure of the non-EGSS is quite similar to the structure of the total economy. The most notable exception is Mining and quarrying of energy producing materials (NACE 10-12) which input structure differs between the non-EGSS part and the total economy. The input shares from Refined petroleum products and chemicals (CPA 23-24) are relatively larger in comparison between the tables.

Table 4. Use structure in the non-EGSS, 2005 (NACE 10-36, CPA 10-36)

Industry (NACE) / Products (CPA)	10-12	13-14	15-16	17-19	20	21-22	23-24	25	26	27	28	29	30-32	33	34	35-36
10-12	19,2%	2,1%				0,1%	56,3%		1,7%	2,9%						0,2%
13-14	4,2%	20,5%	0,1%			1,6%	0,4%	0,2%	13,1%	20,3%	0,3%	0,1%				
15-16			69,4%	4,0%		1,2%	1,3%	0,2%								0,1%
17-19		0,4%	0,1%	48,7%	0,3%	1,5%		1,2%	2,7%	0,1%	0,6%	0,8%		0,3%	0,4%	3,5%
20	27,4%	0,7%	0,4%	0,4%	60,2%	6,2%		0,8%	2,0%	0,3%	1,5%	0,9%	0,6%	0,7%	0,2%	9,4%
21-22		1,0%	9,2%	2,2%	3,1%	62,3%	1,1%	4,0%	5,4%	1,0%	1,6%	2,1%	3,8%	2,5%	0,8%	1,8%
23-24	21,0%	13,9%	5,3%	28,4%	7,4%	16,6%	35,5%	62,1%	22,1%	6,3%	4,8%	2,2%	2,5%	2,9%	1,2%	5,1%
25	14,7%	1,1%	7,8%	3,2%	3,5%	2,6%	2,0%	15,1%	4,7%	0,4%	2,0%	4,3%	2,6%	6,1%	5,3%	4,5%
26		3,0%	1,8%	2,4%	4,3%	0,2%	0,4%	0,8%	30,9%	1,1%	1,9%	0,5%	0,3%	2,8%	1,2%	1,0%
27		0,3%		3,9%	1,8%	0,9%	0,4%	5,3%	8,0%	61,4%	40,1%	13,6%	12,8%	9,3%	6,1%	12,5%
28		6,5%	4,0%	0,6%	13,1%	0,5%	0,7%	3,6%	6,1%	3,6%	36,1%	21,8%	4,1%	8,0%	8,2%	10,4%
29	11,4%	48,3%	1,5%	3,4%	4,6%	5,5%	1,3%	4,5%	2,0%	1,8%	4,6%	37,2%	1,6%	6,7%	6,2%	5,4%
30-32	2,1%	1,1%	0,3%	0,6%	0,8%	0,7%	0,5%	2,2%	0,7%	0,5%	3,8%	10,3%	70,2%	29,1%	2,9%	4,9%
33							0,1%				0,3%	1,1%	0,6%	31,3%	0,1%	0,9%
34		0,6%									0,9%	4,4%			64,2%	1,0%
35-36		0,5%		2,2%	0,8%				0,7%	0,3%	1,3%	0,8%	0,8%	0,2%	3,3%	39,3%

In the continuation of this report we use these input structures in order to perform input-output analyses to finally end up with an estimate on the effects on suppliers to the EGSS production.

3.2 Input-output analysis

In this section we will briefly go through the Input-Output analysis (IOA) performed using the new input tables, the sets for the EGSS and the "non-EGSS" respectively. The sets stem from the input table for the total economy where the "non-EGSS" set is basically the total economy minus the EGSS set. From this material we have performed an analysis on the upstream effects due to production within the Swedish EGSS.

The results should be interpreted with caution as the data it is based on, in parts, is based on simple modelling and, more or less, informed guesswork. It is an illustration of what could be done if we had a dataset that covered all variables and industries/products of the EGSS.

3.2.1 Upstream effects of production in EGSS and non-EGSS

The diagrams below show the upstream effects on employment and CO2 emissions, of an additional 1 million SEK (MSEK) of final demand for each of the industries in the EGSS and the non-EGSS.

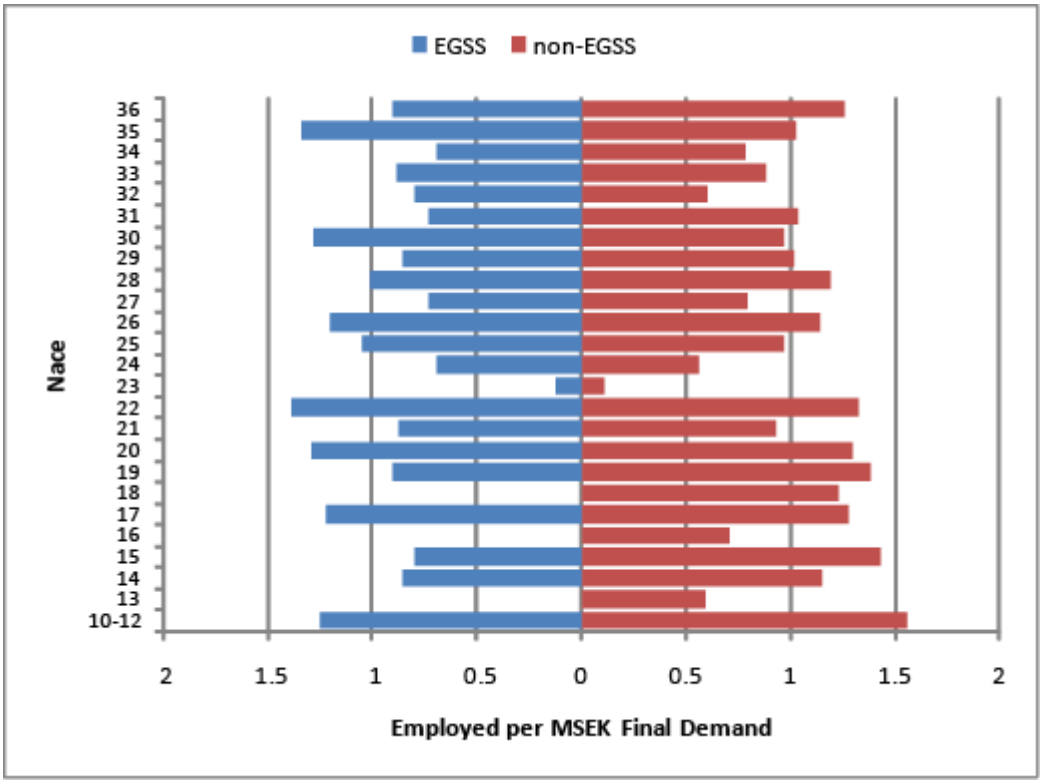

Diagram 1. Effect on employment of additional final demand in each industry in EGGS and non-EGSS.

For example, in diagram 1, if the final demand of products from NACE 10-12 (EGSS) increased by 1 million SEK the total upstream would require additional 1.2 employees. In the non-EGSS NACE 10-12 the same increase would need around 1.5 additional employees. It is important to bear in mind that the increased demand of employees is scattered over all industries and not just from NACE 10-12.

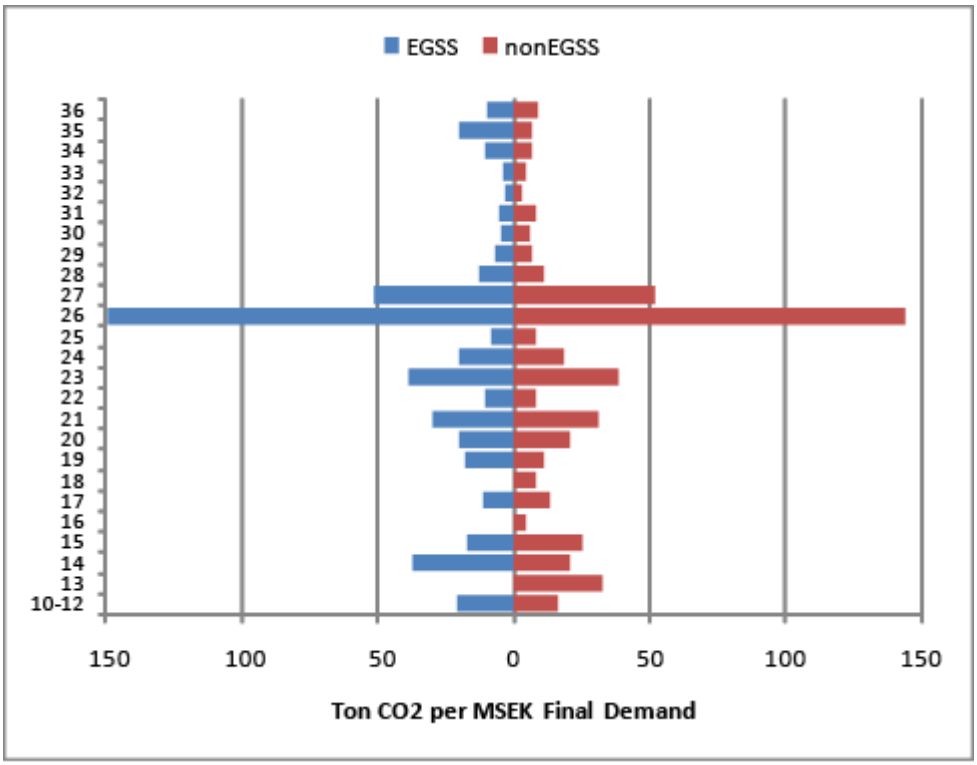

Diagram 2. Effect on CO2-emissions of additional final demand in EGGS and non-EGSS.

The same analysis is made in diagram 2, but for CO2 emissions instead of employment. The diagram shows that an additional million SEK in final demand would generate, for example in EGSS NACE 10-12, around 20 million tonnes CO2 while in the non-EGSS NACE 10-12 it would generate a little less, around 16 tonnes.

The following diagrams show the composition of these upstream effects for the top 5 outputs. It is obviously not the same order between the NACE outputs although 10-12, 20 and 22 are in the top 5 in both. NACE 22 has the greatest upstream employment effect in the EGSS while 10-12 has the largest employment effect in the non-EGSS, see diagram 3.

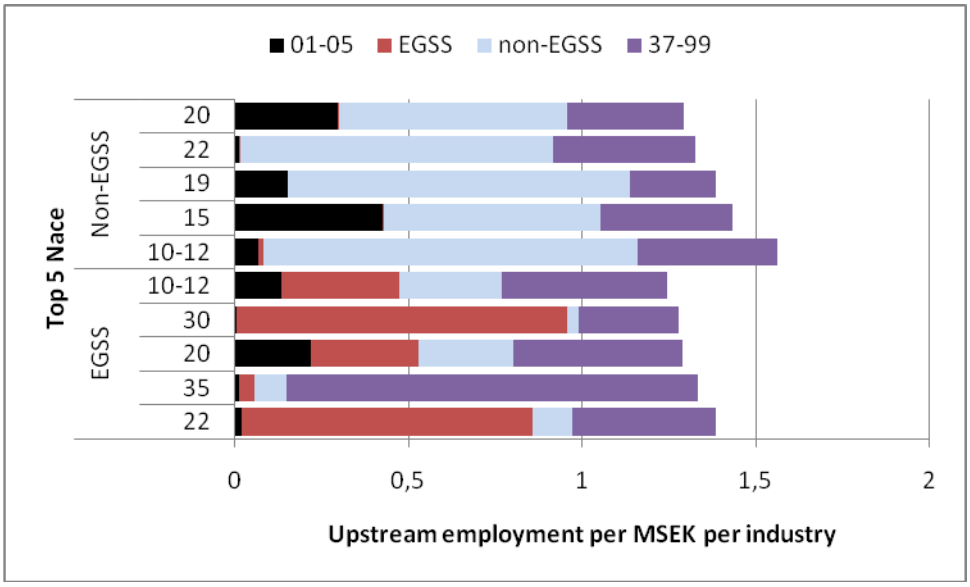

Diagram 3. Distributed upstream employment effect in "top 5" industries.

The CO2 emissions from 1 MSEK of demand have four out of five industries in common for the top 5 industries, see diagram 4. We can also see a substantial difference between the emission multiplier for this output.

It is also apparent that the non-EGSS demand (output) has very little effects in the EGSS, while EGSS demand has some effects in the non-EGSS. Due to the allocation of inputs row-wise the EGSS got a relatively larger share of non-EGSS inputs from NACE 10-36.

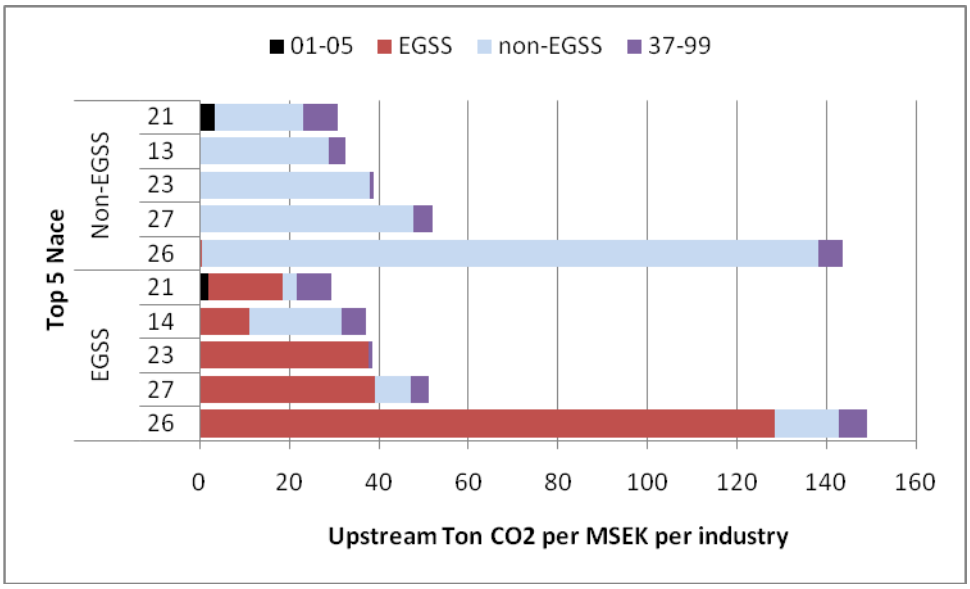

Diagram 4. Distributed upstream CO2 emission effect in "top 5" industries.

Although interesting in themselves, these results are of course built on the assumptions we made in allocating both inputs and emissions across the EGSS and non-EGSS in NACE 10-36. A more thorough analysis has to be done to be able to draw any conclusions from results like these.

3.2.2 Analysis with weighted final demand

The same kind of analysis was also made with a weighted final demand of 1 MSEK, i.e. instead of looking at the effect of 1 MSEK per industry in the EGSS and the non-EGSS we used the share of final demand over NACE 10-36, to allocate 1 MSEK to the whole EGSS and 1 MSEK to the whole non-EGSS.

In table 5 and diagrams 5 and 6 below, we see the results for employment and emissions of CO2 when using the weighted method. We actually have two versions of CO2 emissions. "Version 1" is calculated using a distribution of CO2 emissions per industry over EGSS and non-EGSS based on the shares of production values, i.e. the way we did the split in columns in the use table above. "Version 2" on the other hand was derived by using the shares of inputs from NACE 23 as a proxy for fuel use and emissions. The two approaches produce different results, most apparent in the EGSS although the changes in the non-EGSS follow the same pattern.

Table 5. Weighted employment and CO2 emission effects.

	Employment		CO2 Emissions ver. 1		CO2 Emissions ver. 2	
	EGSS	non-EGSS	EGSS	non-EGSS	EGSS	non-EGSS
01-05	0,03	0,06	1,03	1,73	1,03	1,73
EGSS	0,41	0,00	8,46	0,06	5,28	0,03
non-EGSS	0,11	0,56	3,82	13,65	3,89	13,76
37-99	0,31	0,31	4,03	3,62	4,03	3,62
Sum	***0,86***	***0,92***	***17,33***	***19,07***	***14,22***	***19,14***

In terms of employment effects, the non-EGSS generates 0.92 employed per 1 MSEK of weighted final demand. The EGSS generates 0.86 employed for every 1 MSEK, i.e. 6% less than the non-EGSS.

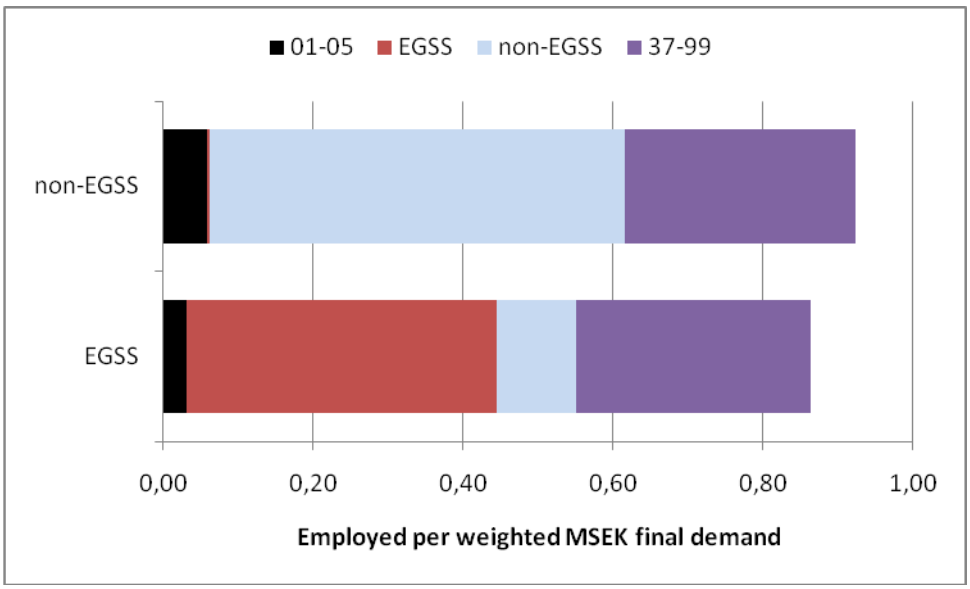

Diagram 5. Upstream employment effects with weighted final demand method.

There is a great difference between the EGSS emissions between the two different ways of allocating the CO2 emissions. The production value based estimate (version 1) produce higher emissions than the NACE 23 inputs based estimate (version 2). Assuming that the survey on industrial use of purchased goods is fairly correct, the lower estimate is the more likely of the two estimates.

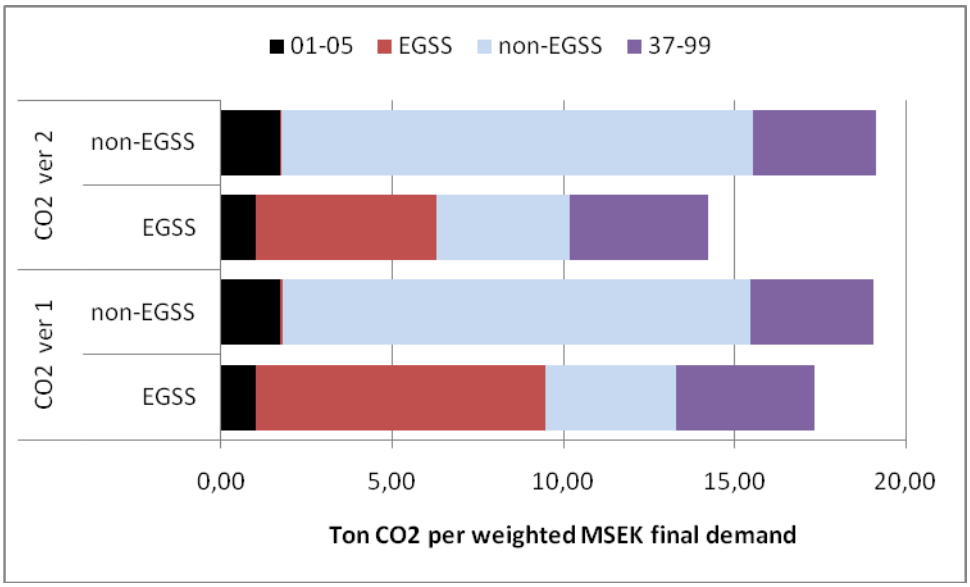

Diagram 6. Upstream CO emission effects with weighted final demand method.

Below in table 6, we see the top 5 contributing industries for employment effects and the share of the total effect accounted for by these 5 industries. For employment we see that the top 5 account for 43% of the total effect for the EGSS, while they only account for 39% for the non-EGSS.

Table 6. Employment effects in "top 5" industries.

Employment			
EGSS		non-EGSS	
29	0,15	**28**	0,08
74-75	0,07	**74-75**	0,08
50-52	0,07	**50-52**	0,07
31	0,04	**29**	0,07
34	0,04	**34**	0,06
Of tot	***43 %***		***39 %***

For emissions we see that the opposite is true. The top 5 industries for the non-EGSS now account for 61% or 62% of the total effect, while the top 5 in the EGSS account for 53% and 59% respectively, depending on which allocation methods used.

Table 7. CO2 emission effects in "top 5" industries, version 1.

CO2 ver. 1			
EGSS		non-EGSS	
27	2,35	**27**	4,13
21	2,18	**26**	2,89
27	1,96	**23**	1,79
26	1,71	**21**	1,43
60	0,95	**24**	1,39
Of tot	***53 %***		***61 %***

The two version of calculating CO2 emissions show that the production value based allocation of emissions produce a more uniform supply structure in terms of contributions to the upstream emissions.

Table 8. CO2 emission effects in "top 5" industries, version 2.

CO2 ver. 2			
EGSS		non-EGSS	
34	3,78	**27**	4,20
27	1,99	**26**	2,94
60	0,95	**23**	1,79
02	0,86	**21**	1,47
403	0,81	**24**	1,41
Of tot	***59 %***		***62 %***

There is obviously a need to go further in the allocation of inputs, not least the fuel use and other environmentally interesting variables.

3.2.3 Estimated employment effect of EGSS

Through the analyses above we have shown the input structure for the EGSS as well as for the non-EGSS. The input-output analyses performed have also exposed the possibility to calculate the effects

of EGSS production. In this subchapter we estimate the upstream employment effect of the production taking place in the EGSS. The estimations are done with the same methodology as above.

As seen in table 9, the employment within the EGSS (NACE 10-36) itself is 15 474. Out of these, seen from a final demand perspective, 11 160 is used producing EGSS output and the others are for other sectors' output (column labelled "Downstream").

Table 9. Employment in EGSS and downstream and upstream effects.

	EGSS employment	Downstream	Upstream
01-05	0	27	663
EGSS (10-36)	15 474	11 160	11 160
non-EGSS (10-36)	0	2 763	2 682
37-99	0	1 524	8 211
Sum	***15 474***	***15 474***	***22 716***

In the column "Upstream" we see the effects of the EGSS production. As shown above, to be able to produce the EGSS output other sectors have to supply the input needed. Hence, this is an estimation and illustration of the suppliers to the EGSS. In diagram 7 the same data as in table 9 is shown.

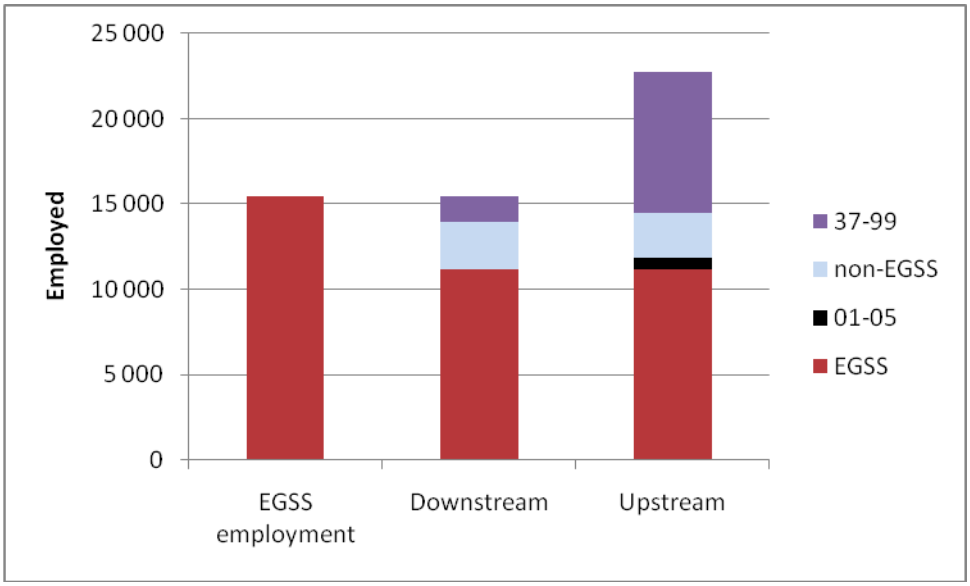

Diagram 7. Employment due to EGSS production.

The diagram show, in a clear way, that the final demand on EGSS products has effects for other industries outside of the EGSS. The total number for "Upstream" says 22 716 and 11 160 of them is within the EGSS itself. This indicate that for every employed person within the EGSS there is one more employed needed upstream in the supply chain to produce EGSS output.

4. Discussion and conclusions

The purpose of this project was to search into methods of estimating the size of the upstream effects due to the production within the Swedish EGSS, i.e. the suppliers to EGSS. The second aim was to actually estimate the size of the suppliers. In this quest we have, as shown in the preceding chapters, employed sources as the survey of industrial use of purchased goods (INFI), use tables from the National accounts and the population from the Swedish EGSS database. To make the estimations we have used the input-output analysis.

The results show differences between the EGSS and the non-EGSS in terms of input structure as well as differences regarding intensities expressed as employment per MSEK final demand and CO2 emissions per MSEK final demand. As we have seen in the use tables for EGSS and non-EGSS presented in the chapter above, the input structure concerning the sets differs from each other. The reasons of these differences are really out of the scope in this project. Though, the fact that the EGSS consists as a subset of, and of a different mix of industries than the total economy represented in the full use table is a reasonable cause to the differing structures. The design of the INFI-survey could also be an explanation to this. When using a small population, as the EGSS, the survey sample in INFI might bias the result so that data from a certain number of enterprises within the EGSS is missing.

In the case of the input-output analyses and employment, the non-EGSS seem to be more work intensive than the EGSS since another MSEK final demand in the non-EGSS give rise to a higher increase in employment as shown in table 5. When it comes to CO2 emissions, it seems that another MSEK final demand produce less emissions in the EGSS than in the non-EGSS. It is difficult to draw any far reaching conclusions out of these results. In the case that our assumptions (and guesswork) are reasonable the results might be interpreted as that the EGSS has another production mix than the rest of the economy, this leading to a less labour and CO2 intensive business activity.

The other part of the purpose of this project was to end up with an estimation of the size of the suppliers to the EGSS. The result showed that for each person employed in the actual EGSS one more employed is needed in the supply chain to produce the output from EGSS. This means that the EGSS' production has an impact stretching outside the main production of environmental goods and services. The result gives an idea about the size of the suppliers – let alone the many assumptions needed to perform the analyses – and it is interesting and possibly usable. As was said in the introduction to this report, stakeholders and users have expressed interest in information on the supply chain leading to EGSS production. Even though the assumptions in this work sometimes have been a bit daring this project makes use of underlying data and methodology that can be refined into a robust tool to further explore the production chain regarding EGSS.

A few remarks can be made on the sources and the methodology. There is clearly a limitation that we only had access to the use of goods (according to the INFI-survey) as we only could perform proper analyses at the NACE 10-36 level. As the service sector (here defined as NACE 37-99) grows in importance in economies such as Sweden's, the need for proper data in this sector is large. Of course, the area of EGSS is not the only one with this need, let alone that the area of EGSS so far is a small statistical field. The National accounts solve the problem of data shortage in this sector in certain ways that we, in this project, not have had the resources to explore in detail and apply to our material. Thus, one conclusion is that to be able to perform an analysis in total conformity to the national use tables, closer cooperation with the National accounts is necessary. In such cooperation, the idea of splitting all industries in the use table might seem overly ambitious. One plausible path forward could be to choose one or a few important industries and carry out a proper split into one layer for the EGSS and another for the non-EGSS part of the specific industry. In such manner we could go through the input-output step with "real" data in the use table with proper splits also in terms of final uses.

Appendix

CPA	Classification of Products by Activity
C01	Products of agriculture, hunting and related services
C02	Products of forestry, logging and related services
C05	Fish and other fishing products; services incidental of fishing
C10	Coal and lignite; peat
C11	Crude petroleum and natural gas; services incidental to oil and gas extraction excluding surveying
C12	Uranium and thorium ores
C13-14	Metal ores / Other mining and quarrying products
C14	Other mining and quarrying products
C15-16	Food products and beverages / Tobacco products
C16	Tobacco products
C17	Textiles
C18	Wearing apparel; furs
C19	Leather and leather products
C20	Wood and products of wood and cork (except furniture); articles of straw and plaiting materials
C21	Pulp, paper and paper products
C22	Printed matter and recorded media
C23	Coke, refined petroleum products and nuclear fuels
C24	Chemicals, chemical products and man-made fibres
C25	Rubber and plastic products
C26	Other non-metallic mineral products
C27	Basic metals
C28	Fabricated metal products, except machinery and equipment
C29	Machinery and equipment n.e.c.
C30	Office machinery and computers
C31-32	Electrical machinery and apparatus n.e.c./ Radio, television and communication equipment and apparatus
C32	Radio, television and communication equipment and apparatus
C33	Medical, precision and optical instruments, watches and clocks
C34	Motor vehicles, trailers and semi-trailers
C35	Other transport equipment
C36	Furniture; other manufactured goods n.e.c.
C37	Secondary raw materials
C40	Electrical energy, gas, steam and hot water
C41	Collected and purified water, distribution services of water
C45	Construction work
C50-52	Trade, maintenance and repair services of motor vehicles and motorcycles; retail sale of automotive fuel / Wholesale trade / Retail trade
C51	Wholesale trade and commission trade services, except of motor vehicles and motorcycles
C52	Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods
C55	Hotel and restaurant services
C60	Land transport; transport via pipeline services
C61	Water transport services
C62	Air transport services
C63	Supporting and auxiliary transport services; travel agency services

C64	Post and telecommunication services
C65	Financial intermediation services, except insurance and pension funding services
C66	Insurance and pension funding services, except compulsory social security services
C67	Services auxiliary to financial intermediation
C70	Real estate services
C71	Renting services of machinery and equipment without operator and of personal and household goods
C72	Computer and related services
C73-74	Research and development services / Other business services
C74	Other business services
C75	Public administration and defence services; compulsory social security services
C80	Education services
C85	Health and social work services
C90	Sewage and refuse disposal services, sanitation and similar services
C91	Membership organisation services n.e.c.
C92	Recreational, cultural and sporting services
C93	Other services
C95	Private households with employed persons

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01	Agriculture, hunting and related service activities
02	Forestry, logging and related service activities
05	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing
10	Mining of coal and lignite; extraction of peat
11	Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12	Mining of uranium and thorium ores
13	Mining of metal ores
14	Other mining and quarriying
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of pulp, paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuels
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastic products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office machinery and computers
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers

35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.
37	Recycling
40	Electricity, gas, steam and hot water supply
41	Collection, purification and distribution of water
45	Construction
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
55	Hotels and restaurants
60	Land transport; transport via pipelines
61	Water transport
62	Air transport
63	Supporting and auxiliary transport activities; activities of travel agencies
64	Post and telecommunications
65	Financial intermediation, except insurance and pension funding
66	Insurance and pension funding, except compulsory social security
67	Activities auxiliary to financial intermediation
70	Real estate activities
71	Renting of machinery and equipment without operator and of personal and household goods
72	Computer and related activities
73	Research and development
74	Other business activities
75	Public administration and defence; compulsory social security
80	Education
85	Health and social work
90	Sewage and refuse disposal, sanitation and similar activities
91	Activities of membership organisation n.e.c.
92	Recreational, cultural and sporting activities
93	Other service activities
95	Private households with employed persons

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