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The effect of household consumption patterns on energy use and greenhouse gas emissions: Comparison between Spain and Sweden

Master's Thesis in Industrial Ecology - for a Sustainable Society

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Abstract

The purpose of this study is to provide a better understanding of the effect of increasing income on energy use and greenhouse gas (GHG) emissions by analyzing Spanish household consumption patterns and afterwards, comparing them with Swedish household consumption patterns (Nässén et al, 2009). In order to carry out this goal, the relationship between household expenditure and both energy use and CO_2-eq emissions are calculated with the help of input-output methodology. Furthermore, a regression analysis is used to evaluate how energy use and CO_2-eq emissions change when there is an increase in household expenditure on a certain commodity. Additionally, this study also provides an empirical contribution to the literature focused on understanding consumer behavior and options to change towards more sustainable consumer practices.

In this research, three analyses have been performed. In the first one, the Spanish case is analyzed and it shows that energy use and CO_2-eq emission are strongly linked to household expenditure. Subsequently, the Spanish consumption patterns are investigated with respect to the Swedish intensity factors (i.e. energy and GHG emissions). As an outcome, energy use linked to these consumption patterns is similar to the first study whereas GHG emissions would decrease by more than half if Spain had the Swedish production system. Finally, the Spanish and the Swedish cases are compared. Both countries have similar consumption patterns on average and on the margin; the former are dominated by housing and food products while the latter are dominated by mobility, luxury goods and leisure services. These patterns shift implies an increase by almost 0.9% in energy use and 0.85% in GHG emissions when income is increased by 1% for both countries. However, there are some small differences in the composition of consumption patterns in both countries that influence the total energy use: Swedish households use 27% more energy than Spanish households implying 15% more GHG emissions.

Keywords: consumption patterns, energy use, greenhouse gas emissions, household expenditure

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List of Abbreviations:

COICOP	Classification of Individual Consumption According to Purpose
CPA	Classification of Product per Activity
GHG	Greenhouse gas emission
IDAE	Institute for Diversification and Saving of Energy
INE	National Statistics Institution
IOA	Input-output analysis
IPCC	International Panel on Climate Change
LCA	Life cycle assessment
MARM	Ministry of the Environment and Rural and Marine
MICT	Ministry of Industry, Tourism and Trade
NACE	National classification of economic activities in the European Union community
OECD	Oranisation for Economic Co-operation and Development
SIOT	Symmetric Input-Output Tables

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) has found evidences that the increasing average temperature of the Earth is very likely due to the increasing concentration of greenhouse gas (GHG) emissions linked to human activities (IPCC, 2007). That is why, in order to stabilize atmospheric GHG emissions concentration at a level that would prevent dangerous anthropogenic effect on the climate system, IPCC has suggested that developed countries[1] would have to reduce GHG emissions 80-90% below 1990 levels by 2050 (IPCC, 2007). Strategies for CO_2-eq abatement are mainly focused on technical change, product design, fuel change; however, IPCC has highlighted the need for a change in consumption patterns as a part of the solution to reduce GHG emissions (IPCC, 2001).

Aligned with it, the consumption choices of households play an important role in energy use and GHG emissions. Households challenge to limit or reduce the demand of energy service per monetary unit, while increasing their affluent level. Understanding consumption patterns and consumer behavior is essential to evaluate and design environmental policies that encourage a reduction of CO_2 emissions and a sustainable development.

The quantification of the energy use and GHG emissions intensity of household consumption patterns is crucial to investigate how to reduce the energy use and GHG emissions. This is to determine the required physical flows, i.e. the primary energy use and the produced GHG emissions related to consumption. Besides, it is necessary to understand which household consumption categories contribute more to energy use and which ones are likely to reduce both energy and CO2-eq emissions.

Input-output analysis (IOA) has been used as a tool to estimate environmental pressure and household consumption at the national level. There is a wide range of studies in this field and all of them conclude that household income is coupled with energy use and GHG emissions. However the composition of consumption patterns seems to be important for the total requirement of physical flows.

As examples of Spanish studies: Labandeira and Labeaga (2002), estimate CO_2 intensities per sector in the Spanish economy for 1992; Roca and Serrano (2007), quantify in general terms, the relationship between income increase and CO_2 emissions among other atmospheric pollution; and Duarte et al. (2009), analyze the relationship between Spanish household consumption patterns for different income levels and GHG emissions. Other inspiring examples of international work using IOA are: Vringer and Blok (1995), and Kerkhof et al. (2008), estimating the effect of increasing income on energy use and environmental pressure at the product level in The Netherlands. Reinders et al. (2003) compare household energy requirements in countries within the

[1] IPCC refers specifically to the countries from Annex I, which include the industrialized countries that were members of the OECD (Organization for Economic Co-operation and Development) in 1992, plus countries with economies in transition (the EIT Parties), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

European Union; and Lenzen et al. (2006) carry out a similar analysis but with different countries in the world. There are some examples of IOA combining other techniques aimed to improve the analysis. For instance: Girod and Haan (2010), who use IOA with LCA (life cycle assessment) to distinguish between quantity and quality within a product category; and Baiochi et al. (2010), who include geographic consumer segmentation data in order to determine the emissions associated with different lifestyles and regions.

In fact, there are many studies that analyze the relationship between environmental impact and household expenditure. However, there are fewer studies that attempt to understand consumer motivation and possibilities to change towards more sustainable consumption patterns. Some of these studies have as starting point the structuration theory, where consumption choice is seen as a mix between individual choices and the prevailing structure (i.e. infrastructure and social norms) (Giddens, 1984). In the same train of thought, Shove (2003), Spaargaren (2003) and Røpke (2009) among others, provide theoretical framework for understanding consumer behavior on a daily life basis from the theory of practice perspective; they refer to ordinary consumption as inconspicuous consumption since it is embodied in daily life practices and does not entail any reflection. Nevertheless, there are other products that people acquire consciously by their symbolic meaning (Dittman, 1992; Elliott and Wattanasuwan, 1998). This latter consumption is related to how people construct the social reality and how they want to communicate to others their place in such reality (Douglas, 1976). Carlsson et al. similarly mention that consumers acquire some products to compare themselves respect to others and by these means they establish their social position (Carlsson et al., 2007). As a specific example of empirical studies, Jesper (2008) discusses the relationship between environmental awareness and household consumption of electricity, heating and water in Denmark and gives some recommendation to modify consumer behavior by means of adding information and symbolic meaning to products.

The general aim of this study is to provide a better understanding of the effect of household consumption patterns on energy use and GHG emissions. The main focus is on determining the effect of increasing income on energy use and GHG emissions by analyzing household consumption patterns in Spain. The resulting outcomes for the Spanish consumption patterns are compared with a similar study that examines Swedish consumption patterns (Nässén et al, 2009). Additionally, this study also attempts to provide an empirical contribution to the literature focused on understanding consumer behavior and options to change towards more sustainable consumer practices.

In order to carry out the analysis of the income effect on energy use and GHG emissions in Spanish households, two steps are performed: first, the relationship between Spanish household expenditure and both energy use and CO_2-eq emissions are calculated with the help of input-output methodology. Second, a regression analysis is used to evaluate the change in household expenditure on a certain commodity when income is increased. This variation in household expenditure is called marginal consumption.

According to the best of our knowledge, the novelty of this study lies in the regression analysis of expenditure at the product level in Spain and the detailed comparison, product by product for Spain and Sweden. Furthermore, besides analyzing the impacts of current consumption patterns, this analysis also attempts to provide a greater perspective on how to understand these behaviors and a shift towards sustainability.

The report is structured as follows. In Section 2, the used method in this study is described, which consists of an IOA and a multivariate regression analysis. In Section 3, the used data for the IOA is listed and the process undertaken to get such data is explained. In Section 4, the results regarding Spanish household expenditure and energy use are presented: at the household level and at the product level. In Section 5, the model limitations are discussed, the results for the Spanish case are compared with the Swedish case and finally, all results are discussed. To end with, in Section 6 some conclusions are drawn.

2. Method

This chapter explains the different steps developed to achieve the objective of this thesis, i.e. to examine the effect of income change on both energy use and GHG emissions in Spain. In order to carry out this goal, the relationship between Spanish household expenditure on both energy and CO_2-eq emissions are estimated by calculating: firstly, energy and CO_2-eq intensities per monetary unit linked to products with the help of IO methodology (Section 2.1); and secondly, the volume and composition of household consumption with the help of data on household expenditure (Section 2.2). Finally, a regression analysis at the product level (Section 2.3) shows the change of products expenditure when income is increased. By the contribution of all these steps, the impact of income change on energy and GHG emissions is obtained.

It is important to emphasize that this chapter relies mainly on four papers; the first two Sections are based on Roca and Serrano (2007), Duarte et al. (2009) and Kerkhof et al. (2008) and the regression analysis section is based on Nässén et al. (2009).

2.1. Input-output analysis

IOA is used to calculate the relationship between environment and an economy, in physical and in economic terms respectively. IO methodology is a top-down economic technique that uses national statistics for trade between all industry sectors within a country to consider all the upstream processes taking part in the production of a certain product. In other words, it analyzes the intermediate consumption of each industry participating in the production chain for that product (Nielsen, 2001). This methodology uses monetary unit as the functional unit, as a result it allocates environmental pressure (e.g. energy use/GHG emissions) of all upstream processes in a product production to the monetary unit linked to the product (e.g. price). For a more detailed introduction into the IO methodology and its applications to environmental issues, see Leontief and Ford (1970).

IOA is used to quantify both energy use and GHG emissions per monetary unit when consuming a certain good or service. Direct and indirect energy use and GHG emissions are calculated for 116 COICOP[2] products coming from 46 NACE[3] economic activities (see Table A1 for the list of the COICOP products and Table A2 for the classified economic activities according NACE classification). On one hand, direct energy use and GHG emissions are related to the household consumption of products, such as vehicle fuels. While on the other hand, indirect energy use and GHG emissions refer to the production of consumed commodities by households. The latter indirect flows are estimated by means of IOA.

According to the above stated, direct (e_{direct}) and indirect factors ($e_{indirect}$) need to be considered when a product is consumed. These factors are expressed in terms of intensity, or in other words, of physical unit per monetary unit. The total intensity associated with product consumption is the result of adding up the direct and indirect components, stated in Equation 1. The calculations of these factors are explained in detail below:

$$\mathbf{e_T} = \mathbf{e_{direct}} + \mathbf{e_{indirect}} \qquad \textbf{(1)}$$

On the initial stage, direct energy use and direct GHG emission related to household consumption of energy products are calculated. These energy products are linked to housing use, such as natural gas, liquefied gas, liquid fuels and solid fuel; in the same fashion, these products can be linked to car use, such as fuels and lubricants[4] (Roca & Serrano, 2007). As an initial step the prices of such products need to be known in terms of monetary unit per energy content. (Duarte et al, 2009). Prices of energy products are obtained from IDAE (2010) and MICT (2010) as of January 2010. These prices are adjusted from 2010 to 2005 according to *Consumer Price Index* (INE, 2010) (see Table 1) because all intensity factors are expressed in the base of 2005 prices (see Section 3).

Table 1: Direct energy use intensities for the energy products.

COICOP	Energy product	Euro/KWh	Euros/MJ	MJ/Euro (2010)	Factor 2010/2005	MJ/Euro (2005)
04.5.2	Natural gas and liquefied gas (butane)	0.044	0.012	82	1.174	69.75
04.5.3	Liquid fuels (fuel oil)	0.048	0.013	76	1.174	64.38
04.5.4	Solid fuel (wood, coal, peat...)*	0.011	0.003	320	1.174	272.33
07.2.2	Fuels and lubricants	0.104	0.029	35	1.174	29.53

*Solid fuel is constituted by approximately 45% wood, 55% coal-derived, see Table A7

[2] Classification of Individual Consumption According to Purpose
[3] National classification of economic activities in the European Union community
[4] The following COICOP products have been considered: 04.5.2 natural and liquefied gas, 04.5.3 liquid fuels, 04.5.4 solid fuel and 07.2.2 fuels and lubricants. However 04.5.1 electricity has not been included since the emissions are allocated to the electricity sector.

The coherence of these results is tested by multiplying expenditure on these products (taken from *Household Budget Survey*, see Section 2.2) by the obtained energy use intensity from Table 1; their sum is similar to the total direct energy consumption by households (INE, 2006) (see Table A3).

Once the energy intensities are calculated, GHG emissions intensities can be quantified by knowing the content of equivalent carbon dioxide per unit of energy use. In order to fulfill this requirement, the compendium of the Chalmers course Sustainable energy future 2009 has been used. The results are shown in Table 2.

Table 2: Direct GHG emissions intensities for the energy products.

COICOP	Energy product	Kg CO2/MJ	MJ/Euro	kg CO_2/Euro
04.5.2	Natural gas and liquefied gas (butane)	0.050	69.75	3.49
04.5.3	Liquid fuels (fuel oil)	0.073	64.38	4.72
04.5.4	Solid fuel (wood, coal, peat...)	0.023	272.33	6.24
07.2.2	Fuels and lubricants	0.073	29.53	2.17

On the second stage, IOA is used to estimate indirect energy intensity and indirect GHG emission intensity associated with a product purchase. With this purpose, the intensity factors of each economic activity in Spain are calculated with the help of the Leontief inverse matrix, and then, they are converted to intensities linked to products and services by using the supply coefficient between sectors and products. This is calculated with the help of the following equation:

$$\mathbf{e_{indirect}} = \mathbf{Q^t(I - A)^{-1}H} \qquad \textbf{(2)}$$

where Q is a 1x46 vector that shows direct energy consumption (or $Q^t_{emission}$ for GHG emissions) per monetary unit for 46 NACE economic activities (MJ/Euro or Kg CO_{2eq}/Euro); $(I\text{-}A)^{-1}$ is 46x46 Leontief inverse matrix for the Spanish economy (including imports); A is 46x46 input-output coefficient matrix, which represents the trade between different economic sectors in the Spanish economy (Euro/Euro); I is an identity matrix; and H is a 46x116 matrix transforming 46 NACE economic activities into 116 COICOP products by means of the supply coefficient between the activity sectors and the products (Euro/Euro) (see Section 3 for further information).

It is important to highlight some established assumptions to carry out the IOA in this report. For example, imported products are assumed to be produced with identical intensity factors as domestic items. An assumption related to homogeneity explains that all industries within the same sector have the same intensity factors (Lenzen, 2001; Nielsen, 2001). These assumptions among others may bring some uncertainties and limitations for the data, see Section 5.1.

IOA is meant to estimate total intensity linked to household consumption, in physical units per Euro. Subsequently, such intensities are multiplied by household expenditure data in order to obtain total energy use or GHG emissions per household. The data collection and its preparation process are explained in the next section.

2.2. Household expenditure

The household expenditure data have been collected from the *Spanish Household Budget Survey 2007* (INE, 2009a), which covers 21,542 households. This source classifies expenditures following the Classification of Individual Consumption According to Purpose (COICOP), published by the United Nation Statistics Division, where the expenditure data is disaggregated into 4-digit COICOP corresponding to 116 categories of goods and services. Moreover, the *Spanish Household Budget Survey* provides information that allows classifying household by some socioeconomic factors such as: income level, region, members' age, education level, city size or type of housing area.

Household data have been collected for the total household members, regardless of their characteristics and number. So that, household expenditure and household size are adjusted by means of the Modified OECD scale (equivalent scale) in order to obtain a household unit that allows a comparison between different types of households. This scale assigns a value of 1 to the household head, 0.5 to each additional adult member and 0.3 to each child (members under 14) (OECD Social Policy Division, 2007). Once this scale is applied, the data are adjusted to household size by getting a consumption unit (c.u.); in this way, all different types of households can be compared with each other.

Now, Equation 3 can be applied to quantify both energy use and GHG emissions per each surveyed household.

$$\mathbf{E_T} = (\mathbf{e_{indirect}} + \mathbf{e_{direct}})\mathbf{M} \qquad \textbf{(3)}$$

where $e_{indirect}$ and e_{direct} are the intensity factors, which have been calculated previously; M is a 116x21,542 matrix, meaning total household expenditure per consumption unit (for all the 21,542 surveyed households) on 116 product categories (Euros/(year•c.u.)); and E_T is a 1x21,542 matrix representing total household energy use per consumption unit (MJ/(year•c.u.)) or total GHG emissions per consumption unit (Kg CO_{2eq}/(Euro•year)) for each household.

At this point, household consumption patterns and their contribution to GHG emissions in Spain have been calculated. In the following section the effect of income on these consumption patterns is evaluated by means of regression analysis.

2.3. Regression analysis

The purpose of this linear regression analysis is to evaluate the effect of income on consumption patterns and its contribution to both energy use and GHG emissions. Regressions are used to analyze the expenditure elasticity at the product level, which means how expenditure on a certain product changes when there is an increase in total household expenditure. Thereafter, this change in expenditure is translated into energy use and GHG emissions with the help of the total intensity factors e_T (per energy use and CO_{2eq} emissions) resulted from the IOA. Just for the sake of clarity, the values of total household expenditure have been taken as disposable income[5].

In this current study, two regression approaches have been considered: at the household level and the product level. The former is used to estimate the relationship between household income and both energy use and GHG emissions in general terms. The latter is used to quantify the relationship between total expenditure and expenditure on each product of the 116 considered categories.

In the first approach, the relationship between household income and both energy use and GHG emissions is analyzed by means of a simple regression. In this regression analysis, income is the independent variable and the physical factor (i.e. energy use or GHG emissions) is the dependant variable. Afterwards, a set of socioeconomic independent variables is added to the model aiming to increase the coefficient of determination (R^2) that results in an improvement of the model. This set, shown in Table 3, has been chosen according to two criteria: relevance to the model improvement (high R^2) and if it does not cause co-linearity to the model.

In the second approach, at the product level, a multivariate regression is performed for each considered COICOP product in this paper. In this analysis, income is the independent variable and expenditure on certain product is the dependant variable. Furthermore, the previous set of socioeconomic independent variables is also added to this analysis at the product level. The improvement of the R^2 and the lack of co-linearity should be checked as well.

Table 3: Set of independent variables used for all regressions[6] [7]

Name	Meaning	Class
members <14	Members aged under 14 years	Continuous
members =>18	Members aged over 18 years	Continuous
14-17 years old	Members aged 14-17 years	Continuous
High education	Top education (University)	Dummy
Low education	Primary education	Dummy
Large city	>100.000 inhabitants	Dummy
Rural	Rural residence area	Dummy

[5] The amount of money one has left after paying taxes.

[6] Andalucía has been removed from the set of variables since it has caused some problems when running the model.

[7] For instance: a residence area can be rural or urban but only the rural variable is introduced. The same case is given to analyze the size of the municipality, which can be large or small, and only the large city variable is introduced in this model.

Aragón	Geographical Region	Dummy
Asturias	Geographical Region	Dummy
Baleares	Geographical Region	Dummy
Canarias	Geographical Region	Dummy
Cantabria	Geographical Region	Dummy
Castilla y León	Geographical Region	Dummy
Castilla la Mancha	Geographical Region	Dummy
Cataluña	Geographical Region	Dummy
Valencia	Geographical Region	Dummy
Extremadura	Geographical Region	Dummy
Galicia	Geographical Region	Dummy
Madrid	Geographical Region	Dummy
Murcia	Geographical Region	Dummy
Navarra	Geographical Region	Dummy
País Vasco	Geographical Region	Dummy
La Rioja	Geographical Region	Dummy
Ceuta y Melilla	Geographical Region	Dummy

As a result of the regression analysis at the product level, the regression coefficient for income represents the marginal consumption for such product. Thus, marginal consumption is the variation in expenditure on a certain product when income is increased by one unit. In the same way, each coefficient of the regression equation indicates the marginal change for the corresponding variable; however, this study is focused on income coefficient since it is the key to understand the effect of income on consumption patterns.

3. Data

This chapter describes the process undertaken to get each matrix used in the IO analysis, particularly in the Equation 2 and 3. For this process, the *Manual of Supply, Use and Input-Output Tables* published by Eurostat (2008), has been followed. The matrices used in this study are explained below:

- *Direct input matrix.* It is calculated for both direct energy use (Q) and direct GHG emissions ($Q_{emission}$) (See Table A4 and Table A5 to visualize Q and $Q_{emission}$ respectively); nevertheless, only one of them is explained here.

The Q matrix is a 1x46 vector containing the total energy used by 46 NACE economic activities per monetary unit (MJ/Euro). The first step to build up this matrix is to collect the consumed energy data by each NACE economic activity from *Environmental Account 2002* (INE, 2006). The next step is to divide the data, in energy units, by the total expenditure of a certain industry, taken from the *Spanish National Account 2005* (INE, 2009b), using the output at basic prices for each economic activity.

Notice that the process to obtain $Q_{emission}$ is the same as the one developed to get Q; however, the difference is the supplied information from the *Environmental Account* about *Atmospheric Emissions Satellite Accounts* by economic activity, classifies separately the production of CO_2, NO_2 and CH_4; consequently, all emissions are translated into equivalent CO_2 emissions.

- *The Leontief inverse matrix* ($(I\text{-}A)^{-1}$): It is a 46x46 matrix, which represents the trade between 46 NACE economic activities (including imports) in the Spanish economy expressed in basic prices (Euro/Euro) (See Table A6).

The *Spanish National Account 2005* (INE, 2009b) provides the Leontief inverse matrix for 73 homogenous branches of activity SIOT[8] every five years. However, this Leontief inverse does not match the 46 NACE economic activities of the Q matrix; that is why a new 46x46 Leontief inverse matrix needs to be built. For this purpose, the *Symmetric input output table at basic price 2005* (R) (INE, 2009b) is taken as a starting matrix. Notice that this matrix is transformed to be expressed in terms of 46 SIOT activity branches (equivalent to the 46 NACE economic activities) instead of 73 SIOT activity branches (see Table A2 for the correspondence between 73 SIOT activities and the 46 NACE economic activities). Once, R is a 46x46 matrix, all intermediate inputs of a sector are divided by the total production of such sector. As a result, the matrix of input-output coefficients A is obtained.. From this A (46x46), one can calculate the expression $(I\text{-}A)^{-1}$ and get the new Leontief inverse matrix representing the 46 economic activities (see Figure 1).

$$R_{(73\times73)} \rightarrow R_{(46\times46)} \rightarrow Aij = \frac{Rij}{pj}, i,j = 1 \dots 46, p = \ total\ production\ of\ sector\ j \rightarrow A_{(46\times46)} \rightarrow (I-A)^{-1}{}_{(46\times46)}$$

Figure 1: Steps to obtain the 46 x 46 Leontief inverse matrix

- *Matrix of transformation coefficients (H).* It is a 46x116 matrix that turns the production of 46 NACE economic activities (used in the for Leontief inverse matrix) into 116 COICOP products (See Table A7).

No readymade table relating both products categories, NACE and COICOP, has been found for the Spanish economy; nonetheless, some recommendations on

[8] Homogeneous branches of activity used in the Symmetric Input-Output Tables (SIOT).

how to build up this transformation matrix have been obtained in Ezequiel et at. (2005) and Causapé et al. (2004). The last one explains the construction process for the transformation matrix for the Zaragoza economy. Based on those articles, there are mainly two steps required to construct the transforming coefficient matrix:

First, the correspondence between the COICOP products category and the linked products to the production of NACE economic activities shall be found. For this purpose, some intermediate steps are required:

- Correspondence between COICOP 1999- CPA[9] 2008 and between CPA 2008-CPA 2002. There is a correspondence table between these products categories for both transformations published by the classification service Ramon Eurostat (2009). By using them, all 116 COICOP products are related to at least one of the 95 CPA products.

- Correspondence between CPA 2002-SIOT is given by the Symmetric I-O table Classifications: NACE/CPA correspondence (INE, 2009b). When applying this correspondence, 116 COICOP products are related to at least one of the 46 SIOT activity branches (equivalent to the 46 NACE economic activities).

It should be noted that most products have a bi-univocal relationship with the production branches, meaning that one product is related to one production branch; nevertheless, around 35% of the COICOP products correspond to more than one branch. This is a complicated situation that is solved by applying the next step.

The second stage involves estimating and allocating the distribution percentages for these products (35 % of the products) in their respective production branches with the help of extra statistical sources. Some of these sources are related to sector-specific surveys; for example statistics provided by the MARM (2007) is used to estimate the distribution for food and beverages products in their production branches. Besides this estimation, some others are performed based directly on the *Supply table form input-output framework for Spain 2005* (INE, 2009b), by taking the *Household final demand* vector into account for some calculation.

After using these extra sources, there is no information about the distribution into their respective production branches for only 20% of the products. That is why, a simple assumption like an homogeneous distribution has been assumed for these products. Thereafter, the conversion matrix H can be assembled. It is worthy to say that the sum of each coefficient per column must be equal to one.

[9] Classification of Product per Activity.

In other words, a product can come from various productive activities but all the coefficients regarding a product should add up one.

To sum up, the calculation of the matrix H is based on looking for the correspondence between the classification COICOP-CPA-SIOT and on using statistics data from sector-specific surveys and also from TIOA (input-output tables) to allocate the distribution percentages for products in their respective production branches.

- *Demand matrix (M):* It represents total household expenditure on 116 categories of goods and services (at 4-digit COICOP) of 21,542 households.

  This is a 116x21,542 matrix expressed in Euros/(year•c.u.). It is important to state that the expenditure data have been aggregated at 4-digits COICOP as INE provides data at 5-digits COICOP (around 300 products). This disaggregation level has been chosen based on the Swedish study carried out by Nässén et al. (2009) with the purpose of comparison with that study.

4. Results

4.1. Income effect at the household level

In this section, the income effect at the household level is analyzed by examining the relationship between household income and both energy use and GHG emissions in general terms. First, this relationship is investigated by means of univariate regressions aimed to have an overview of the household trends. Afterwards, this relationship is analyzed by using a multivariate regression in order to get more accurate results and to evaluate the effect of other variables, such as socio-cultural and geographical factors (Section 4.1.1).

The relationship between income and energy is shown in Figure 2, which plots total energy per consumption unit and total household expenditure per consumption unit for the 21,542 surveyed households. The regression line fits the data well, with a coefficient of determination (R^2) of 0.607; the line shows an increase of 6.13 MJ in energy use when income is increased by 1 Euro. However, when studying separately the effect of low and high income on energy use, it is noted that as income rises the energy use increases at a slower rate. For low income groups (expenditure lower than 17,830 Euro/(year•c.u.)) the energy use grows by 7.395 MJ when income is increased by one Euro; whereas, for higher income group, the growth for energy use is 5.537 MJ for the same income change. This means that at higher income levels, the marginal consumption is less energy intensive than at lower income levels.

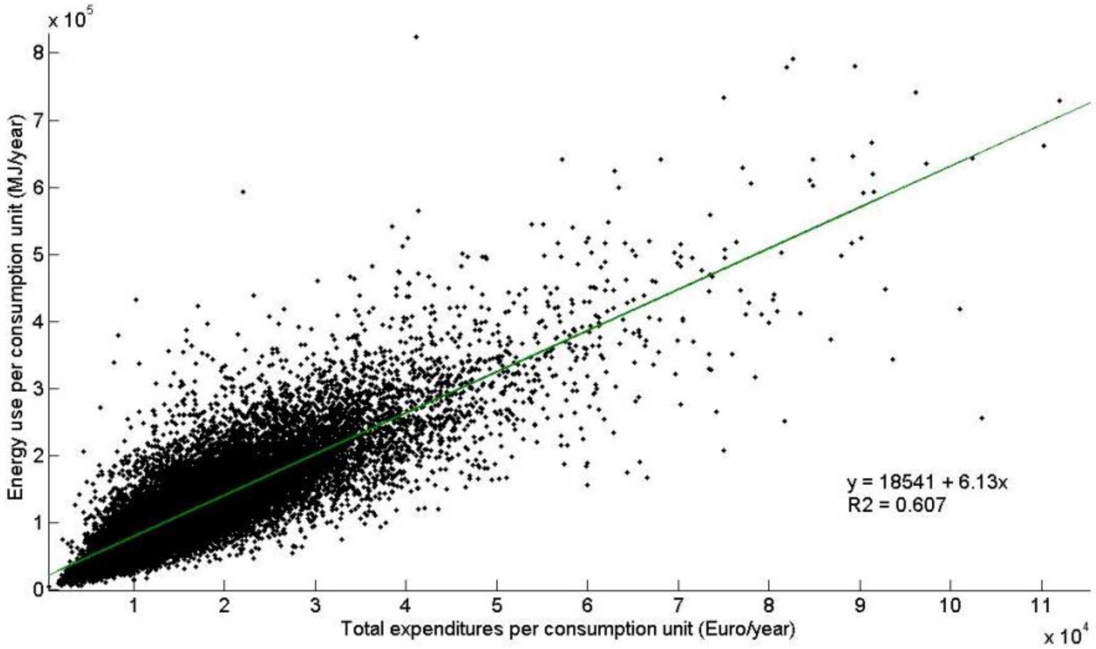

Figure 2: Energy use and total expenditure for Spanish Household in 2007.

Figure 2 shows that there is a variation in energy use within the same income group. For instance, a household with an income level of 20,000 Euro/(year•c.u.) uses 0.66 x 10^5 MJ/(year•c.u.) while other uses 2.5 x 10^5 MJ/(year•c.u.). The same trend can be observed within other income levels. This means that there are households using around 3.8 − 3.4 times the energy used by other households within the same income group. This variation in energy intensity might depend on other non-economical factors; that is why, a set of socio-cultural and geographical factors is included in this model (see next section). Figure 2 also illustrates that the results spread out in a large manner for low income than for high income (R^2 is 0.35 and 0.55 respectively). This fact indicates that there is a great number of factors (non-economical) affecting energy use for low income than for high income level.

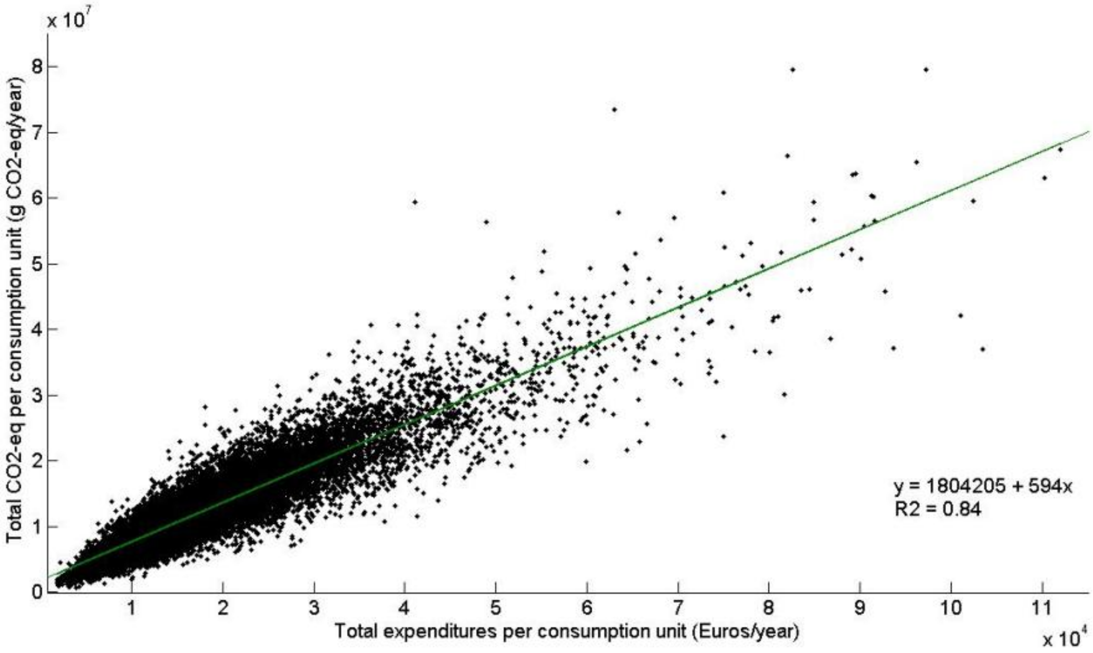

Figure 3: CO_2-eq emissions and total expenditure for Spanish Household in 2007.

Regarding the relationship between income and CO_2-eq emissions, Figure 3 shows that the model properly fits the data with a R^2 of 0.84, which means that GHG emissions mainly depend on expenditure. There is an increase of 594g CO_2-eq in GHG emissions when expenditure increases in one unit.

4.1.1. Socio-cultural and geographical effect

A set of socio-cultural and geographic variables (Table 3) is included in the model in order to improve it and to provide a better understanding of what may influence energy use. When this set of variables is added, the adjusted R^2 of the regression line grows from 0.607 to reach 0.782 meaning that approximately 80% of household energy use can be explained by this model.

It is important to highlight that most of the variables used in this model contribute significantly to explain what happens with the dependant variable, i.e. the energy use. However, Cataluña, Baleares and Extremadura do not contribute significantly to improve the regressions model; they do not have a significant effect on energy use, so to speak[10].

[10] Most of the used variables in this model are significant at a level of 0.1. Only the variables High Education and Cantabria are significant at a level of 5%; while the variables Cataluña, Baleares and Extremadura are significant at higher levels than 5%.

Table 4: Pair-wise correlation between regression variables. Colors are added to the table to visualize the sign and the magnitude of the correlation. Pink is used for negative and blue for positive correlation, while the color intensity is linked to the magnitude intensity.

Pearson Correlation	Total energy	Total expenditure	members <14	members =>18	14-17 years old	High education	Low education	City size	Rural	Castilla y Leon	Castilla la Mancha	Cataluña	Valencia	Extremadura	Galicia	Madrid	Pais vasco
Total energy	1.000	.866	.159	.437	.099	.149	-.296	-.042	.026	-.005	-.001	.018	-.035	-.048	.016	.058	-.004
Total expenditure	.866	1.000	.159	.384	.101	.218	-.337	.051	-.093	-.057	-.042	.048	-.008	-.064	-.035	.079	.048
members< 14	.159	.159	1.000	-.043	-.052	.106	-.168	-.027	-.040	-.044	.016	.005	-.006	-.011	-.032	.028	-.007
members =>18	.437	.384	-.043	1.000	-.034	-.108	-.098	-.039	.046	-.020	.011	-.037	-.009	.012	.026	.003	-.025
14-17 years old	.099	.101	-.052	-.034	1.000	-.007	-.072	-.011	-.002	-.017	.008	-.008	.007	.023	-.016	-.010	-.019
High education	.149	.218	.106	-.108	-.007	1.000	-.255	.134	-.129	-.015	-.039	.011	-.014	-.028	-.028	.080	.059
Low education	-.296	-.337	-.168	-.098	-.072	-.255	1.000	-.108	.155	.021	.051	-.024	-.002	.061	.045	-.048	-.079
City size	-.042	.051	-.027	-.039	-.011	.134	-.108	1.000	-.338	-.056	-.137	.036	-.026	-.102	-.071	.200	-.002
Rural	.026	-.093	-.040	.046	-.002	-.129	.155	-.338	1.000	.140	.174	-.104	-.077	.170	.107	-.133	-.094
Castilla y Leon	-.005	-.057	-.044	-.020	-.017	-.015	.021	-.056	.140	1.000	-.062	-.085	-.076	-.057	-.068	-.069	-.085
Castilla la Mancha	-.001	-.042	.016	.011	.008	-.039	.051	-.137	.174	-.062	1.000	-.074	-.067	-.050	-.059	-.061	-.074
Cataluña	.018	.048	.005	-.037	-.008	.011	-.024	.036	-.104	-.085	-.074	1.000	-.092	-.068	-.081	-.083	-.102
Valencia	-.035	-.008	-.006	-.009	.007	-.014	-.002	-.026	-.077	-.076	-.067	-.092	1.000	-.061	-.073	-.075	-.092
Extremadura	-.048	-.064	-.011	.012	.023	-.028	.061	-.102	.170	-.057	-.050	-.068	-.061	1.000	-.055	-.056	-.068
Galicia	.016	-.035	-.032	.026	-.016	-.028	.045	-.071	.107	-.068	-.059	-.081	-.073	-.055	1.000	-.067	-.082
Madrid	.058	.079	.028	.003	-.010	.080	-.048	.200	-.133	-.069	-.061	-.083	-.075	-.056	-.067	1.000	-.084
Pais vasco	-.004	.048	-.007	-.025	-.019	.059	-.079	-.002	-.094	-.085	-.074	-.102	-.092	-.068	-.082	-.084	1.000

It should be mentioned that there is no co-linearity within the variables. This means that there is not a strong correlation between the independent variables within the model. Nonetheless, the variables are not independent of each other. Table 4 shows a pair-wise correlation between all regression variables. The relationship between each pair of variables does not take into account the effect of the rest of them.

On the other hand, the effect of each variable on energy use is examined by means of the standardized coefficients, see Figure 4. The regression coefficients are estimated along other independent variables, considering the existence of all the variables within the model. These coefficients are standardized primarily because they allow comparison among them and so that, they show the relative weight of each variable in the regression equation.

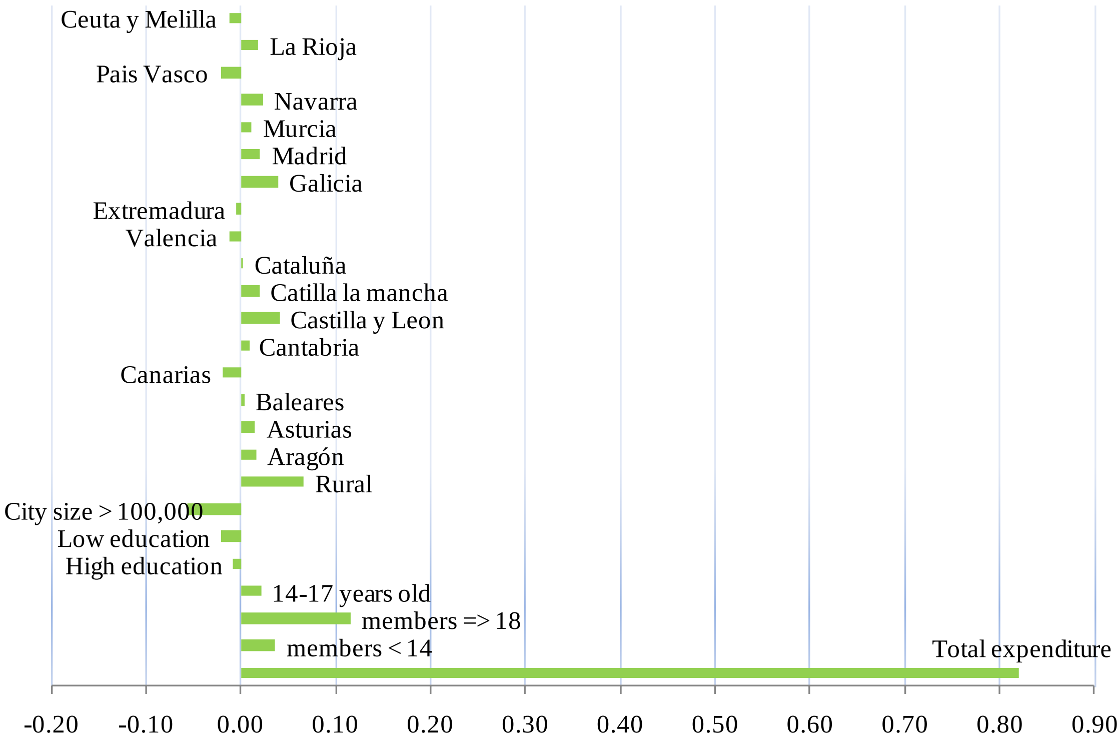

Figure 4: Standardized coefficient (Beta).

As a result of analyzing Figure 4, one can conclude that energy use is strongly shaped by income level for most of the surveyed households; nevertheless, the energy use is also influenced by socio-cultural and geographical factors. The effect of the non economic variables is in the following descending order:

- The household size, i.e., number of household members and their age. The greater the number of people living under the same roof (furthermore, whether they are adults or not), the biggest the effect on energy use per household is. However, it also must be taken into account that people living in the same house share electricity and other energy usages, so that, the more people living in the same household, the lower the energy use per capita is (see Section 2.2 to see the effect of an extra household member in the consumption unit).

- Location and size of the resident area. Living in a rural area seems to require a larger amount of energy to fulfill the same living needs than living in a urban area. This is because in rural areas more electricity and vehicle fuel are required, fact that might be related to the bigger household size and higher dependency of private vehicle use in rural areas, generally speaking. In the same fashion, living in a big city (more than 100,000 inhabitants) requires less energy than living in a smaller city. This fact may be connected to mobility aspects since big cities often have better public transportation and are more compact; thus, the use of private transportation decreases, leading to a reduction in vehicle fuel consumption.

- Living in different regions has different effects on energy consumption according to the specific characteristics of the region. For example, living in Castilla León, Castilla La Mancha, Galicia (regions with large rural areas and small cities), and Madrid has a positive relationship with the energy consumption. Whereas, living in País Vasco or Valencia (regions with few rural areas but middle city size) involves needing less energy. Finally, living in Extremadura, Cataluña, Baleares and Murcia does not have any effect on energy use.

- The level of education. Households with primary school level may have a less energy intensive life style than households with higher educational level; nonetheless, households with high education level do not seem to have different consumption patterns to other households, energy-wise.

4.2. Income effect at the product level

In this section, the income effect on energy use and GHG emissions is investigated at the product level. This is to examine the effect of increasing income on expenditure on a certain product by performing a multivariate regression for each products consumed by households. This change in product expenditure (when income increases) is called marginal consumption, and it is calculated by considering the regression coefficients for income[11]. Thereafter, this expenditure on commodities is translated into energy use and GHG emissions by using the resulting intensity factors for the IOA.

The Table A8 (see Appendix) contains information on average and marginal expenditure share together with the energy intensities and GHG emission intensities for 116 COICOP products. Comparing the calculation of intensity factors, some of these intensities are roughly equal within the same category products because such commodities come from the same industry. For instance, products of the category *Food and non-alcoholic beverages* and *Alcoholic beverages, tobacco and narcotics*, have similar intensity factors; this is because they are provided by the same industry, in this case *Food and Beverage Industry.* Note that initial information on direct energy use and GHG emissions used in the IOA distinguishes only between 46 industries. However, the categories have been disaggregated into 116 products in order to be compared with a similar Swedish study, see Section 5.3.

Table 5 presents the energy intensities and GHG emission intensities related to the average and marginal consumption calculated from Table A8. These figures represent the energy use and GHG emissions when spending one Euro on average and on the margin. It can be observed that consumption on the margin is less energy intensive than consumption on average (6.38MJ against 7.30MJ). When comparing these numbers, intensity factors for average against marginal expenditure, an energy use ratio of

[11] The income regression coefficients are significant at 0.1% level, excluding a few highlighted products in Table A8 (see Appendix)

1 : 0.87 and a GHG emissions ratio of 1 : 0.84 are obtained[12]. These ratios show a strong coupling between income and both energy use and GHG emissions.

Table 5: Energy intensities and GHG emissions intensities for average and marginal consumption.

	Energy intensity (MJ/Euro)	CO2-eq intensity (gCO2-eq/Euro)
Average expenditure	7.30	851.17
Marginal expenditure	6.38	713.17

For a better understanding of what these figures mean (Table 5), the 116 categories in Table A8 have been summed up into 20 aggregate categories to by analyzed in terms of energy unit when spending one Euro on average and on the margin.

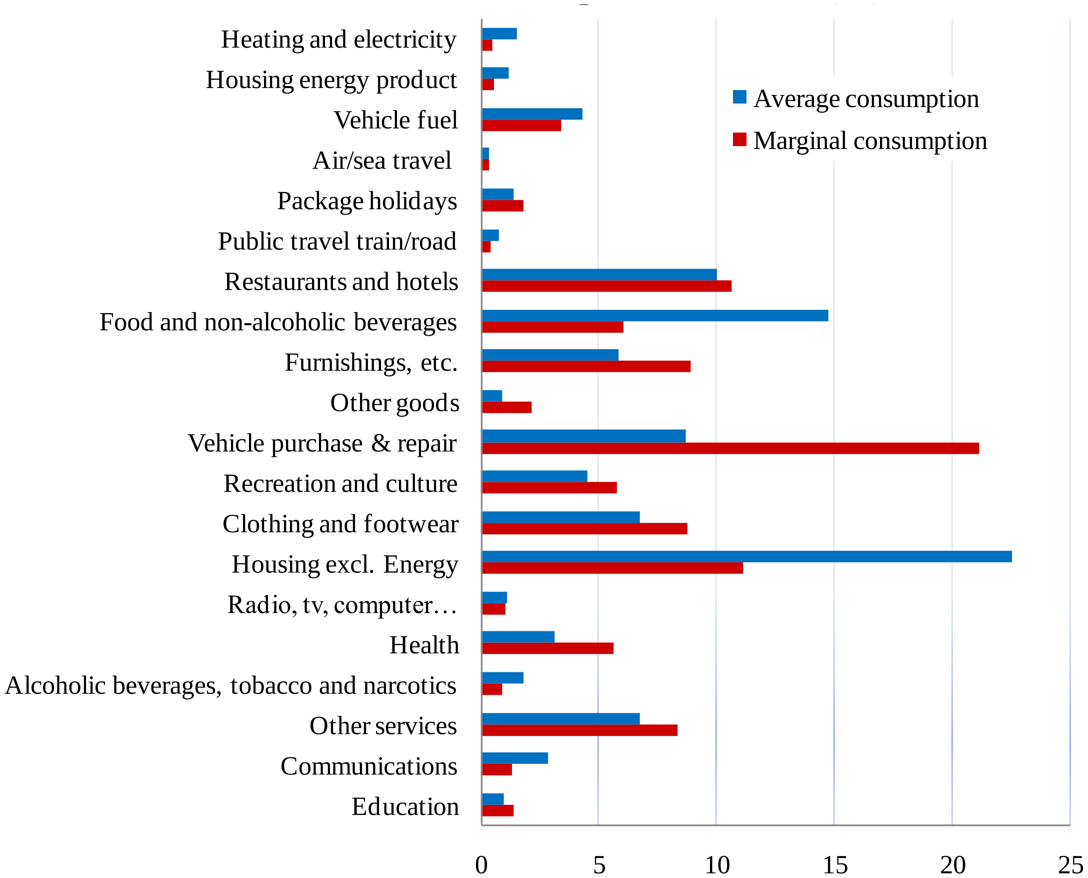

Figure 5: Average and marginal expenditure share (%) in Spain, 2007. Data: summary of the average and marginal expenditure share in Table A8.

The average consumption of the Spanish households is analyzed in terms of energy factors. The average consumption patterns (blue bars of the Figure 5) are mainly defined by a high expenditure share on housing (23%), food (15%), bars and restaurants (10%)

[12] Roca and Serrano (2007) got a slightly larger GHG emissions ratio (i.e. 0.89 vs. 0.84). This difference may be caused because Roca and Serrano have included synthetic gases as GHG gases while this study has not considered them.

and vehicle purchase and fuel (13%), housing energy products and electricity (3%) among others. Some of these products, such as food, housing energy products (butane, propane, natural gas, fuel oil among others), electricity, as well as vehicle purchase and vehicle fuel are high energy intensive (according to Figure 6), meaning that their consumption needs a large amount of energy per monetary unit. The high energy intensive products represent 67% of the total energy use on average consumption (see Figure 7).

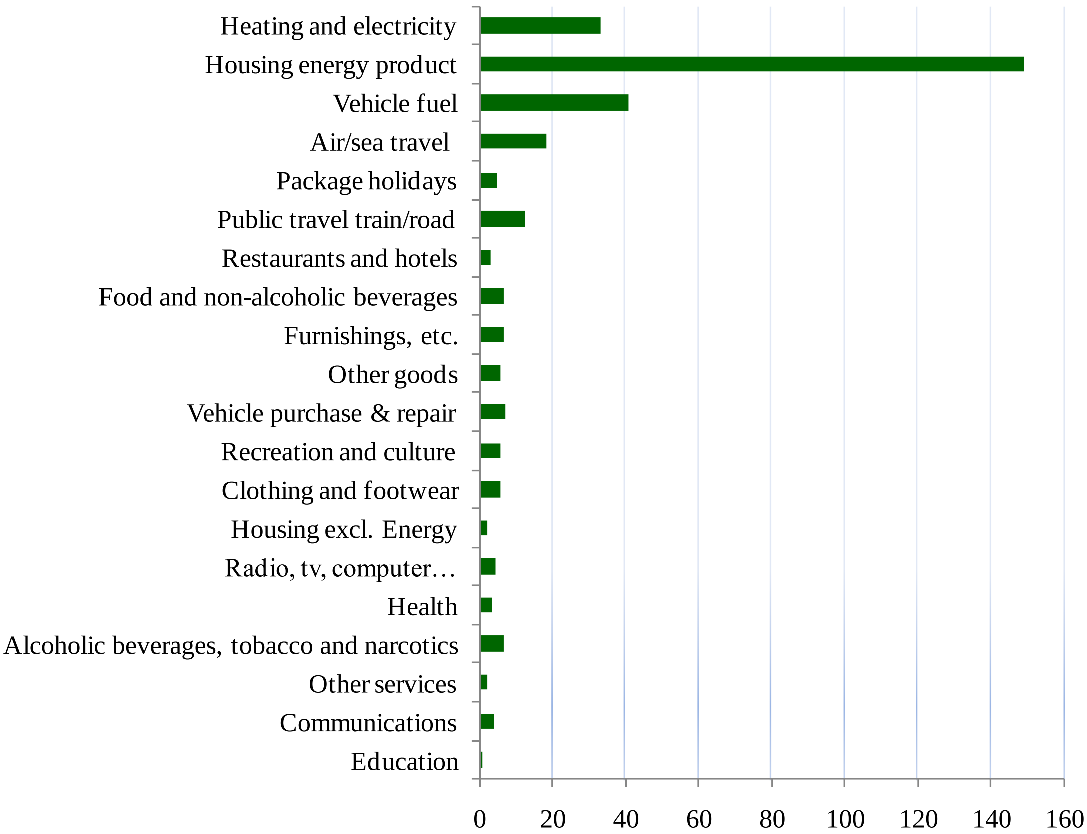

Figure 6: Product energy intensity (MJ/Euro) for Spanish economy 2007. Data: summary of energy intensities Table A8

But what happens when there is an income increase? According to Figure 5 (red bars), when income is increased there is a change in consumption patterns. This change is represented by an increase in expenditure share: vehicle purchase and other goods (e.g. jewelry goods, see Table A8) grow by a factor of 2.5 (from 8.4% to 21%); followed by health, furniture appliances, education, clothing and footwear, package holidays, recreation and culture. These products have expenditure elasticity greater than one, while the rest of goods and services represent the same or lower share on total expenditure (compared to average consumption).

The shift in these pattens when income is increased, implies a reduction in energy intensity from 7.30 to 6.30 MJ per spent Euro (Table 5). This fact is due to the decrease in the share of high energy-intensive products from 67% to 59%; for instance, housing energy products, electricity, vehicle fuel and food decrease the energy use from 5 to 2.7

MJ per spent Euro, while energy use due to vehicle purchase rises from 0.6 to 1.5 MJ per spent Euro. Additionally, big expenditure on luxury goods or social services on the margin does not generate a big energy use per monetary unit (Figure 7).

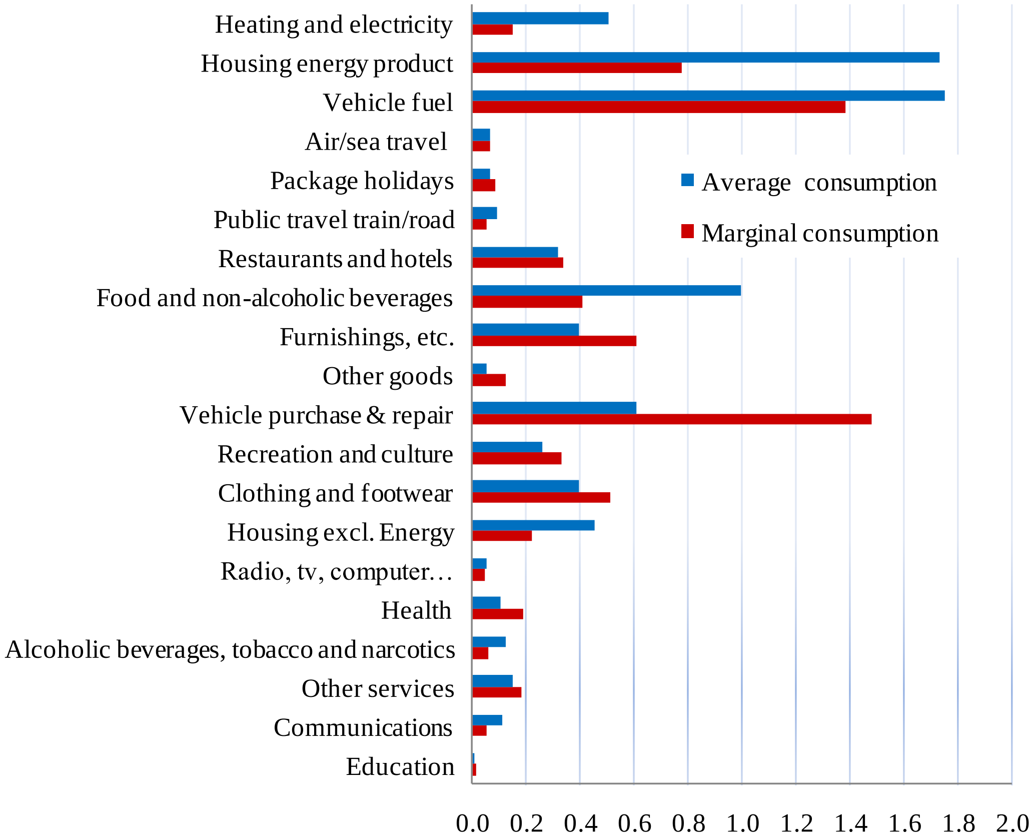

Figure 7: Shares of energy use for average and marginal consumption (MJ) in Spain, 2007.

The shift in these patterns might clarify why households with low income level are more energy intensive per monetary unit than high income level households. Low income households spend a bigger expenditure share on food, energy products and electricity; such expenditure might be similar in absolute terms when income increases, representing a smaller share (of the total household expenditure) for high income households[13]. Consequently, households with low income levels require more energy per monetary unit than high income household. This fact might coincide with Figure 2, showing that the slope is steeper for low income than for high income. And also, it might explain the coupling ratios from Table 5 (i.e. 1: 0.87 for energy use and 1: 0.84 for GHG emissions).

[13] See Duarte (2009) for an analysis and discussion consumption patterns and income redistribution in Spain.

5. Discussions

5.1. Model Limitations

The limitations of the model are influenced by different factors, namely: IO methodology, data quality, the calculation of the transformation matrix (H) and the regression analysis.

The weaknesses of the IO methodology come from some of the established assumptions to carry out the IOA in this project. It is assumed identical factor intensities for foreign industries, which supply commodities for the domestic market, and domestic industries: therefore, there is no distinction between local and imported products. As another assumption, it is taken for granted that the industry is homogeneous, meaning that each industry has only one product and all industries within a sector have one homogeneous technology. As a result, all these industries have the same intensity factors (Lenzen, 2001; Nielsen, 2001). This assumption does not allow considering differences in quality within the same product category; for that reason, the environmental impacts of these products are proportional to their prices: the more expensive, the bigger the environmental impact is. In order to avoid overestimating the environmental impact of expensive products, Girod and Haan (2010) among others, propose to use a hybrid methodology between IOA (top-down) and the Life Cycle Analysis (bottom-up).

Regarding the data quality, the weakness may come with the different disaggregation data level, i.e. between consumed products by households and used energy by the product supply industries. Household expenditure data have been collected from a survey with a rather large sample size, more than 20,000 households at disaggregation level of 116 products. Dissimilarly, the data concerning direct energy and direct GHG emissions are available for only 46 industries, whereas the required level of disaggregation is 116 in order to match the expenditure categories. This difference in number of categories between products and industries may produce some allocation problems over an industry class. For instance, beverage and food industry have the same energy and GHG emissions intensity; consequently, all supplied products by these industries have similar intensity factors. This problem could be solved by aggregating the product category levels. However, such disaggregation level is required in order to compare the Spanish case with the Swedish one.

The calculation of the H matrix may introduce some weaknesses into the model. The H matrix converts the production of 46 NACE economic activities into 116 COICOP products. It is important to emphasize that 20% of these products have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution. However, different distribution ways have been tried out and all of them resulted in rather similar energy intensities. In addition, the 20% explained previously, are items with low expenditure share, fact that might reduce the possibility of error. Most of them belong to the *Recreation and Culture* category*;* for instance, 09.1.2 Photographic and cinematographic equipment, 09.2.1 Other durable goods necessary for leisure and culture, 09.4.1 Recreational and sporting services among others (these products are highlighted in Table A7).

Going back to the regression analysis, it has achieved a good fit of the model and most variables are significant at a level of 0.1%. This fact indicates that the used model in the regression analysis is rather reliable.

This is a cross-sectional study that has been performed for the year 2007. To go a step further in the research, it would be interesting to develop a longitudinal study to analyze the consumption patterns through the years in order to achieve a better understanding of them.

5.2. Spain vs. Sweden Comparison

In this section, the previous results for the Spanish households are compared with those obtained by Nässén et al. (2009) based on Swedish households. It is important to note that this comparison evaluates the energy use and GHG emissions per spent monetary unit and for an average household in both countries.

Figure 8 shows a comparison between the energy use and the expenditure level in Spain and Sweden in general terms. Both graphs illustrate similar trends in the two countries, the energy use is directly proportional to income; however, Swedish households seem to require more energy for the same income level. In order to investigate what makes this difference in energy use, the production system and the household consumption patterns are analyzed below.

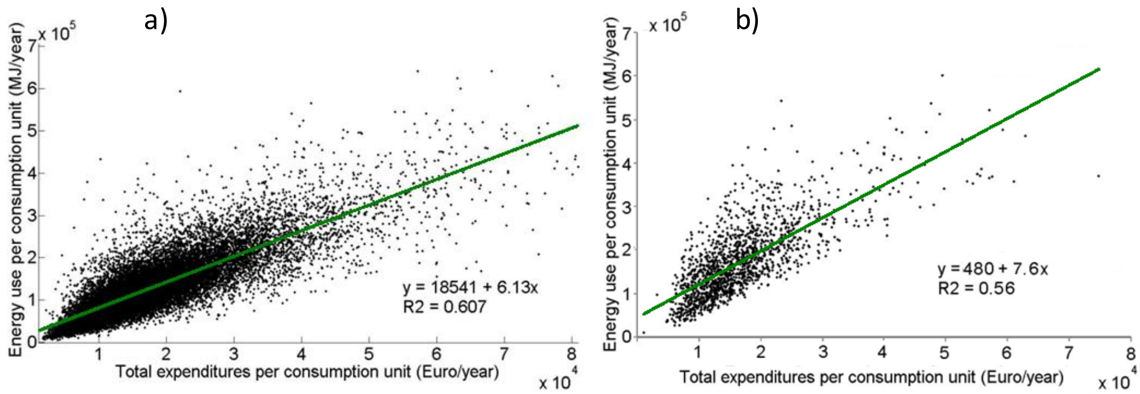

Figure 8: Comparison between energy use and total expenditure for (a) Spanish households in 2007 and (b) Swedish households in 2006. Data: (a) see Section 4.1 for further description and (b) Nässén et al. (2009)

On the one hand, the production systems of the two countries are compared by considering their intensity factors. These intensity factors have been obtained from the IOA and it is important to take into consideration the characteristics of this methodology when comparing these factors in both countries. IOA does not allow an analysis about technology, since the intensity factors are calculated from monetary transaction between all industries involved in the production of a product (see Section 2.1). That is why, energy intensities depend on the price system in each country as well as the relationships between a specific industry with all the upstream industries.

In Figure A1-A12, one can see the energy intensity factors and the GHG emissions factors related to each product category for both countries. In general terms, Spain and Sweden have similar energy intensities linked to products. Actually, Swedish industry uses slightly less energy than Spain to produce the same goods and services; however, there are some exceptions, such as: electricity, food products, package holidays, cultural and recreation services, restaurant and hotel services, among others.

For instance, the electricity and heating category is more energy intensive in Sweden than in Spain. This is due to; first, the electricity price is cheaper in Sweden than in Spain (Europe's Energy Portal, 2011); and therefore, the energy use per monetary unit is bigger in Sweden. Second, because the electricity and heating mix is different in both countries. The Swedish system (European Commission, 2007a) is more energy intensive than the Spanish one (European Commission, 2007b), for example, the electricity in Sweden is produced mainly by hydro and nuclear technologies that need more primary energy to produce a final KWh.

Alternatively, when it comes to GHG emissions, Sweden produces by far the same items with lower GHG emissions[14] (see Figure A1-A12) and this is related to the electricity and heating mix. The Swedish electricity mix is almost CO_2 free (European Commission, 2007a) while in the Spanish production system, only the 40% of the share is CO_2 free (European Commission, 2007b).

On the other hand, consumption patterns in both countries are compared and they seem to be, though not the same, surprisingly similar. In Figure 9, the bars to the left explain the average expenditure share while the bars to the right illustrate the marginal expenditure share in Spain and in Sweden. According to this figure, Spanish and Swedish households seem to fulfill their needs in the same way, the salary share that goes to each goods and services category is rather similar in average and marginal consumption; however, there are some small differences that might influence the energy use.

In the first place, average consumption patterns of both countries are analyzed. The largest share of the salary goes to housing rent, followed by food[15]; this is somehow expected since those products are related to basic needs. In addition, both countries spend on (from the biggest to the lowest share in expenditure) vehicles, restaurant and bars services, cultural and leisure services, clothing and footwear, other services and furnishing. The trend of product consumption seems to be the same for both countries with some slight differences. For example, in Spain 10% of the expenditure goes to restaurant and cafés services, while this percentage is lower in Sweden (less than 5%): Nevertheless, Swedes spend more on recreation and cultural services (8.5% Sweden against 4.5% Spain) package holidays (4.2% Sweden and 1.4 Spain). Although

[14] These GHG emissions intensities can be compared with those obtained by Kerkholf,et al (2008) for Dutch households, whose intensities are closer to the Spanish than to the Swedish ones

[15] These priorities are the same for all the European Union countries according to a study carried out by Eurostat (2008).

expenditure shares on these last products are different in both countries, they all belong to the leisure category[16]. This means that a significant part of the expenditure, more than 15% for both countries, goes to the consumption of leisure products and services, indicating the importance of leisure on total expenditure and then, the relevance on energy use and GHG emissions.

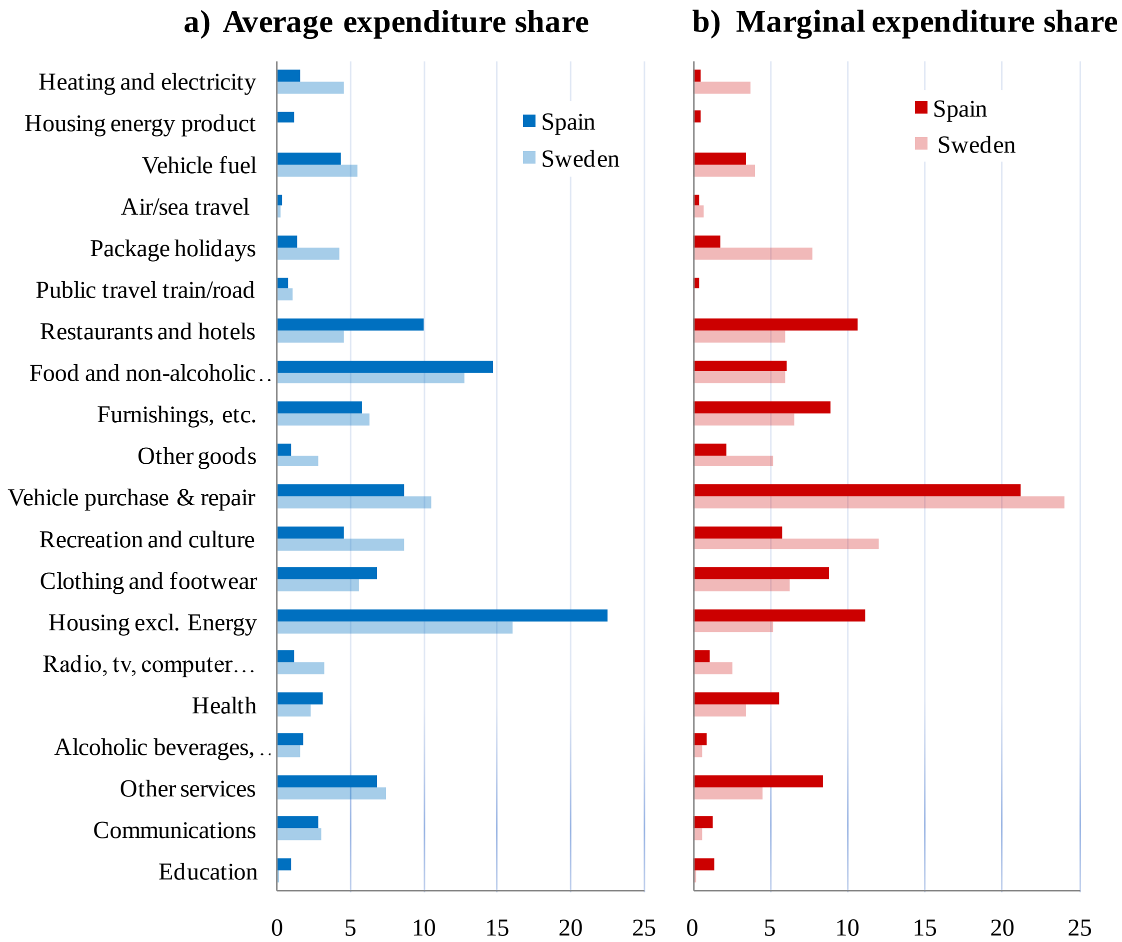

Figure 9: (a) Average and (b) marginal expenditure share in Spain and in Sweden

There are some other differences in average consumption patterns that would explain why Sweden requires more energy per monetary unit than Spain. Swedish households spend a bigger share on electricity (4.3% Sweden against 2.68% Spain[17]), on vehicle fuel (5.58% Sweden against 4.32% Spain), on package holidays (4.2% Sweden against 1.4% Spain) and these products are the most energy intensive as well as the most CO_2-eq intensives. As a result, Swedish households use 10.60 MJ on average (Figure 10-c) while Spanish use 7.30 MJ per monetary unit (Figure 10-a); this makes a difference of 31% on energy use between the two countries.

[16] It is assumed that Spanish people go to restaurant and cafes not only to eat and/or drink but also to socialize and enjoy their free time; therefore, it can be considered as a leisure activity.
[17] Spanish expenditure share includes electricity and housing energy products. These products are exclusively consumed by Spanish households.

In the second place, marginal consumption patterns of both countries are studied. The Spanish and Swedish household consumptions are also similar on the margin. When there is an income increase, the expenditure on vehicle purchase experiences the largest increase to reach a major expenditure share of 20% in both countries. However, these countries have slightly different preferences for the remaining goods. In the case of Spain, the products with larger consumption growth, when increasing income, are in this order: other goods concerning jewels, health, furniture, education, clothing and footwear, package holidays among others. While in the Swedish case, air/sea travels and package holidays, other goods, recreational and cultural, restaurant and hotels are the most consumed products on the margin. Alternatively, food and housing represent a small share on the margin for both countries. High energy intensive products also represent a small share on the margin; however, Swedish households spend a bigger share on this products. As a result, Swedish households use 33% more energy on the margin than the Spanish (9.40 MJ per additional Euro spent in Sweden compared to 6.38 MJ per additional Euro in Spain).

So far, energy use due to consumption patterns have been compared taking into account the intensity factors of the respective country; however, to estimate the energy use that is exclusively due to differences in consumption patterns, they should be compared with the same intensity factors (Swedish factors in this case). Figure 10 shows the energy and GHG emissions linked to one spent Euro on average and on the margin in both countries. Notice that Figure 10-b is built with Spanish consumption patterns and Swedish intensity factors. Firstly, when comparing Spanish consumption patterns with both Spanish and Swedish intensity factors (Figure 10-a and 10-b respectively), some conclusions can be drawn. It can be observed that energy use on average and on the margin is about the same, whereas GHG emissions emitted by Spanish households would decrease by more than half if Spain had the Swedish production system. Secondly, when comparing Spanish with Swedish consumption patterns, both calculated with Swedish intensity factors (Figure 10-b and 10-c respectively), Swedish households appear to be more energy intensive (27% on average and 34% on the margin) than Spanish, and this variation in energy use results in a bigger production of GHG emissions (15%).

After comparing consumption patterns, it can be stated that income is coupled with energy use and GHG emissions in both countries. Similar coupling ratios are obtained for energy and GHG emissions. Spain and Sweden, countries with different culture, have a difference of 2% in their coupling ratios for energy, 1 : 0.87 – 1 : 0.89 and a difference of 3% for GHG emissions, 1 : 0.84 – 1 : 0.87, respectively[18] (Figure 10). Nonetheless, Swedish households are more energy intensive per monetary unit.

[18] Kerkholf, Nonhebel, and Moll (2008) have found a ratio for GHG emissions of 0.84 for the Dutch households. See Lenzen et al. (2006) for a cross country comparison of elasticity for climate change.

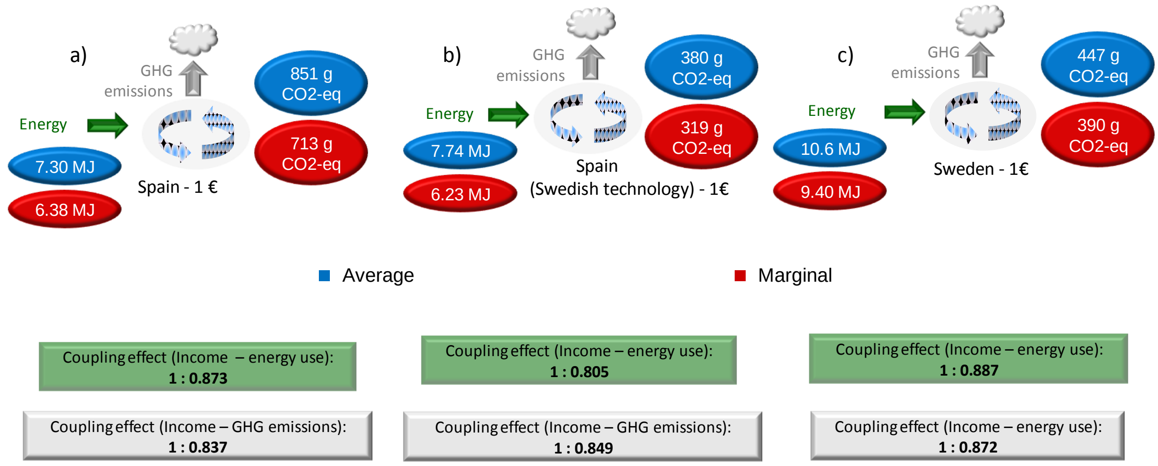

Figure 10: Energy use and GHG emissions when spending one Euro on average and on the margin for a) Spanish households b) Spanish households and Swedish intensity factors c) Swedish households. Data: see Section 4.2 for the Spanish data and see Nässén et al. (2009) for Swedish data. Own elaboration.

Figure 11 shows the energy and GHG emissions flows regarding an average household consumption in both countries. An average Spanish household spent 11,673 Euros/person (17,830 Euros/c.u) (INE, 2009a) while an average Swedish household spent 13,380 Euros/person (20,070 Euros/c.u[19]) in 2007 (Statistics Sweden, 2009). The difference in energy use in both countries is mainly due to different consumption patterns; contrarily, the difference in GHG emissions is due to technological reasons. When it comes to absolute consumption, the difference between these flows in both countries becomes even more relevant, pointing out the importance of both consumption patterns and consumption level in energy use.

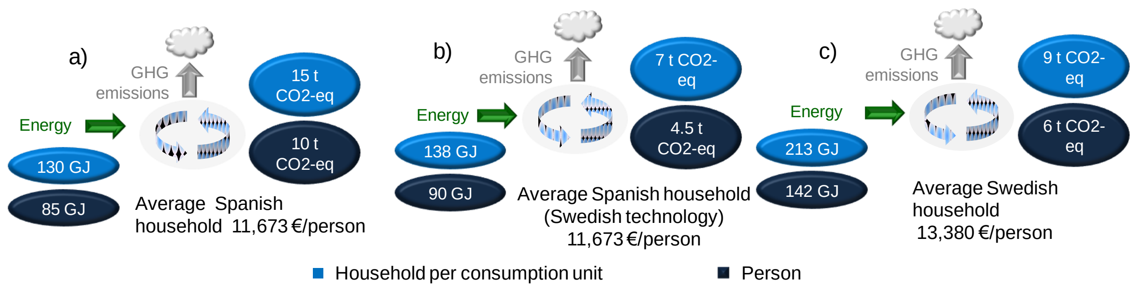

Figure 11: Energy use and GHG emissions for an average a) Spanish household b) Spanish households and Swedish intensity factors c) Swedish households Data: see Section 4.2 for the Spanish data and see Nässén et al. (2009) for Swedish data. Own elaboration.

Both countries have a similar behavior to raise (by almost the same factor) their energy use and GHG emissions when income increases. This similarity suggests that this pattern could be interpolated to other European countries. Moreover, it could also be introduced to other countries of the world. In this sense, The Worldwatch Institute (State of the world 2004, special focus: The consumer society, 2004) highlights the emergence of a global consumer class, where the western lifestyle reaches a wealthy elite belonging to transition economies, summing up to 1.7 billion members in the consumer class (approximately 25% of total population). Such amount of members is

[19] The consumption unit is calculated differently in Spain and Sweden (see Nässén et al. for the Swedish case); however, by knowing the average household consumption, the average number of people, and their characteristics, one can estimate the consumption unit according to the modified OECD scale.

remarkable and it might point out the need for the decoupling between income and energy use.

5.3. Change towards sustainability

According to the previous results, consumption patterns play an important role when it comes to environmental problems, such as GHG emissions and energy use. In this regard, the aim of this section is to examine how to address a consumption patterns shift towards more sustainable practices. For this purpose, a discussion on understanding consumption patterns linked to energy intensive practices is carried out; and thereafter, possibilities of changing to more sustainable consumption patterns are analyzed from the perspective of the theory of practice. Alternatively, insights from this theory are intended to be applied to the two presented cases, i.e. Sweden and Spain.

5.3.1. Key issues related to energy use: Understanding consumption patterns

There are some questions that arise when talking about a shift towards sustainable consumption: what motivates consumer's behavior, energy-wise? What constraints sustainable consumption?

There are different theories that attempt to interpret and explain the motivations that influence consumption. This study intends to provide an empirical contribution to these theories, especially to those whose starting point is the structuralism theory. These theories rely on the idea that consumption is motivated by individual choices but depending on both the pre-existing infrastructure and the prevailing social norms (Giddens, 1984). Aligned with it, the theory of practice (e.g. Shove, 2003; Spaargaren, 2003; Røpke, 2009) sees individuals performing every day activities without conscious reflection and; that is why, consumption embodied in these activities is named inconspicuous consumption. In other words, individuals do not have many alternatives when making a choice in the daily life; they seem to be locked into unsustainable practices even if they are willing to change towards more sustainable behavior (Sanne, 2002).

Analyzing everyday consumption is important from an environmental point of view, since routines seem to require large amounts of energy. Some of the products regarding daily life activities are: food for feeding; electricity for lighting, heating, using housing appliances; fuel for commuting. These activities require a 65% and 50% of the energy use on average and on the margin respectively as seen in the two studied cases in this report. The energy use linked to such routines does not imply a conscious reflection; instead it might be shaped or constrained by other factors, for example:

- There are some constraints related to technical factors, such as, to local/ regional infrastructure. For instance, some Spanish households use housing energy products (e.g. butane, fuel oil, propane among others) instead of electricity, which pollute less, because it depends on the prevailing local infrastructure, either at home or at local suppliers. In the same vein, living in a rural area or small city would contribute to use more energy than living in a big city (i.e. bigger than 100,000 inhabitants) (Section 4.1.1), a fact that could be explained by the required energy for private transportation. Related to technology, Spanish households produce more CO_2-eq emissions than Swedish households, due to the cleaner technology usage by the Nordic country.

- Alternatively, weather factors can explain why Swedish households would need more energy for heating and lighting than Spanish households.
- Institutional norms make the difference between Spanish and Swedish consumption on social services. In Spain, as a household becomes wealthier, it spends more on education and health. While this does not happen in Sweden as its welfare system relies more on public welfare services.
- There are some other constraints regarding social norms that shape daily practices. In this sense, Shove discusses showering and the dynamics to establish shower as a socially accepted daily practice (Shove, 2003). These routines cannot be identified easily in the analysis of the Spanish and Swedish households; however, the similarity of the consumption patterns between these countries might suggest that similar practices are performed and hence, social norms might be rather similar.

All these daily activities are examples of ordinary consumption that apparently does not depend on individual's choices but on structural factors; however, this consumption could be influenced by other conspicuous choices performed in a specific point of time and typically related to symbolic or positional goods. This latter consumption is related to how people construct the social reality and how they want to communicate to others their place in such reality by means of consumption (Douglas, 1976). For instance, deciding where to live or how big the house should be, would determine the commuting and the required electricity in the daily life. In the same fashion, car ownership and car size would also constraint the amount of used fuel. Such decisions are examples of conscious consumption and might be influenced by cultural factors.

When looking at vehicles in Spain and Sweden, they make up a big share of the average consumption (8% − 10%) and it is growing steadily when incomes are increased to constitute 21% − 24% of the total marginal expenditures. This shows that these countries spend the biggest portion of their salaries on vehicle purchases when households become wealthier. This result holds with that of Carlsson et al. (2007) who find that income and cars are highly positional on average. This means that by acquiring these so called positional goods, one wants to communicate values (identity) and symbols, e.g. to belong to a social position (Hirsch, 1976). Consumption of these products implies a social comparison with others; hence, they cause a negative effect on society (Carlsson et al., 2007). This negative externality can provoke a positive feedback, since more money is spent in acquiring more (positional) goods to compete for a high positional level (regarding others); and hence more energy and resources will be demanded.

All the above discussed, endorses that consumer behavior is shaped by material and social context. Conforming to this, individuals seem to be locked into an unsustainable structure and that is why it is difficult to change to a green behavior. Then, is it possible to shift towards more sustainable consumption patterns?

5.3.2. Changing consumption patterns

Daily consumption is seen as a reproduction of habits or practices by scholars who endorse the theory of practice (e.g. Shove, 2003; Røpke, 2009). In this sense, when talking about a shift towards a sustainable consumption, it is important to identify the driving forces shaping these practices, both the context and the individual motivations.

According to Shove and Pantzar (2005), a practice relies on three components: *material*, *meaning*, and *competence. Competence* is related to skills and required knowledge to perform a practice. The *meaning* component refers to the sense of doing an activity, what actually represents to do that activity. The *material* component concerns the objects, i.e. required equipment to carry out the practice (Røpke, 2009). At the same time, practices are dynamic, being able to change over the time and the space. They can change either by altering their composition (innovation processes between the three components), emerging new practices or only by changing the performance of the practice (Shove & Pantzar, 2005). Individuals are who carry out a practice, integrating the three components in their every day practices.

Alter the symbolic meaning of consumption could enhance the emergence of conscious environmental reflection and modify the consumer behavior to a more sustainable one. The theory of practice emphasizes the importance of the competence and meaning components when performing a practice, and this is related to the symbolic meaning of the practice. Then, a lack of reflectivity when doing an activity might constraint the environmental concern related to consumption. Therefore, increasing information (e.g. visualizing energy use embodied in every day practices) and modifying symbolic meaning of consumption by introducing environmental concern or making sustainability an identity value linked to a practice, might help to promote environmental friendly consumption (Røpke, 2009). Jensen, by means of Danish household interviews, found that introducing a green message is not enough to encourage sustainable consumption; instead, other qualities of the products or practices should be highlighted, such as, saving money on the electricity bill, comfort, health, taste, design among others. Besides, it is important to link low energy intensive consumption to normality and simplicity in order to reach a more diverse and big range of people (Jensen, 2006). Hence, change the symbolic meaning of practice could cause a conscious reflection and a change in consumer behavior; for instance, to use more sustainable materials (i.e. material component of a practice) when performing a practice as long as income level allows it (Røpke, 2009).

The emergence of a new practice should be approached from the complex system theory perspective. Shove and Walker remark that consumption is embodied in a complex socio-technical system. In practice innovation, it is important to understand the relationship within the parts and within the system in order to avoid unpredictable and undesirable effects on the entire system (Shove & Walker, 2010). Then, consumer, producer, infrastructure, institution, and all the related elements within a practice should be considered for the innovation process to avoid negative externalities.

This theoretical framework could be applied to the Spanish and Swedish cases in order to provide some inputs for shifting to more sustainable patterns. A good strategy could be to take a look at the low energy intensive households in each country (Figure 8) and indentify these "green consumption patterns"[20] within the same income group as well as the local and regional infrastructure. The driving forces that shape household consumption (the three components), as well as the co-evolution with the socio-technical system should be analyzed in order to understand these consumption patterns and to examine whether these patterns could be extrapolated to other households with the same income level and if so, what are the individual motivations and the local context that shape that consumption.

When it comes to green consumption patterns, leisure plays an important role mainly for two reasons. The first one explains the growth on leisure products and services when income is increased (26% of total expenditure in Sweden); spending more time and money on leisure implies spending less on other categories that might pollute more. The second one elaborates on the different consumption patterns related to leisure, as seen in Spain and Sweden. Some of the leisure practices could be energy intensive while others could not, such as travelling to exotic and faraway places (see Figure 9 where Swedes spend a bigger share on air travel and package holidays than the Spanish). Therefore, it is important to investigate how people fulfill needs leisure-wise and to examine different practices, as well as the emerging ones in order to avoid undesirable effects and rebound effects.

6. Conclusion

The purpose of this master's thesis is to provide a better understanding of the effect of increasing income on energy use and GHG emissions by analyzing Spanish household consumption patterns and afterwards, comparing them with Swedish household consumption patterns. Furthermore, this project also attempts to provide a broader perspective on how to understand these behaviors and a shift towards sustainability.

For an average Spanish and Swedish household, the effect of income on energy use and GHG emissions is somewhat similar. These countries have similar consumption patterns both on average and on the margin. Electricity, housing energy products, food and mobility are the key issues for energy use; nevertheless, only mobility (i.e. private

[20] According to Girod and Haan (2009), Swiss household groups that emit less is because of they consume less meat, car use, household appliances and more leisure.

vehicle) seems to be coupled with income level. When income is increased, expenditure on private car grows steadily and expenditure on luxury goods and leisure products (package holidays, recreational and cultural services, bars and restaurants) grow as well. However, Swedes spend more money on package holidays while Spanish people spend more on restaurants and bars. This analogy between consumption patterns result in a similar coupling ratio between income level and energy use or income level and GHG emissions. When income is increased by 1%, the energy use grows by almost 0.9% for Swedish households and by 0.87% for Spanish households. This fact points out that income is strongly coupled with energy use and GHG emissions. However, there are "less energy intensive households" in each income level in both countries (see Figure 8) that might indicate a possible decoupling with income, due to different consumption patterns. Mobility and leisure aspects seem to be the key challenges for decoupling when income is increased.

When it comes to consumption patterns, a slight difference in their composition of high energy intensive products entails an important difference in the energy use: Swedish households use 27% on average and 34% on the margin, more energy than Spanish households, which involves a 15% more GHG emissions. On the other hand, when it comes to analyze the effect of technology on energy and GHG emissions, households in both countries seem to have similar energy use per consumption unit; however, Swedes produce half the GHG emissions produced by the Spanish for the same consumption patterns. These results point out the importance of consumption patterns on energy use and technology on GHG emissions.

Regarding the consumption patterns understanding, consumption appears to be influenced by the context and the symbolic meaning. The meaning linked to consumption or to a practice seems to be one of the factors that define the performance of such practice; that is why, symbolic meaning in consumption might be used to motivate individuals to change their consumption patterns towards more sustainable ones. In this fashion, the introduction of reflectivity into consumption, such as the visualization of embodied energy, might be important to promote a decrease in energy use and GHG emissions since most energy intensive product categories (electricity, housing energy product, mobility and food) are typically consumed inconspicuously in the daily life. Nevertheless, the consumer is not the only involved party in this matter. It also depends on structural factors (e.g. infrastructure, institution, production among other) and so that, a shift towards more sustainable consumption patterns should come along with collective efforts.

7. Further work

Regarding the methodology, there are some important aspects to take into account for future work. The used methodology in this study, i.e. IOA, is a top down technique that considers that the industry is homogeneous, meaning that each industry has only one product and all industries within a sector have one homogeneous technology. Therefore, environmental impacts of these products are directly proportional to their prices. This assumption does not allow considering differences in quality within the same product category. Hence, it would be relevant to include a bottom-up technique, like Life Cycle Analysis in order to identify “green consumption patterns”, such as ecological food and the acquisitions of environmental friendly products. This would help to recognize a possible decoupling between income and environmentally problems, together with the improvement of their understanding.

Another main aspect regarding the method, has to do with the disaggregation level of the energy use data. The initial data on energy use contains information for 46 different economic activities. That is why, it would be interesting to collect energy information from any extra data source that allows disaggregating these data into more economic activities to obtain a more accurate intensity factor related to products. For instance, differentiate between food products, such as meat and vegetables.

Identifying consumption patterns with regard to socio-geographical aspects is another important aspect worth to consider in future studies. It has been proved that socio-geographical aspects have an effect on energy use in Spanish households; therefore, it would be important to identify consumption patterns not only with economic factors but also with socio-geographical ones. In the same vein, as the material and social context might influence consumer behavior, it would also be interesting to analyze household consumption on the basis of the same context, such as, a region, a town or even a neighborhood in order to examine similarities and differences in consumption patterns, if any; and compare them with other geographical areas.

As a final recommendation, this thesis is a cross-sectional study for the year 2007. To go further in the understanding of consumption patterns, it would be interesting to analyze the patterns through the years. It also would be relevant to analyze how the economic crisis has affected consumption patterns.

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A. Appendix

A.1. Classifications

Table A1: COICOP codes for 116 products

Code	COICOP PRODUCTS
	Food and non-alcoholic beverages
01.1.1	Bread and cereals.
01.1.2	Meat.
01.1.3	Fish.
01.1.4	Milk, cheese and eggs.
01.1.5	Oils and fats.
01.1.6	Fruits.
01.1.7	Vegetables including potatoes and other tubers.
01.1.8	Sugar, jams, honey, chocolate, sweets and ice creams.
01.1.9	Nourishing products not included previously.
01.2.1	Coffee, tea, cocoa.
01.2	Mineral waters, fizzy beverages and juices.
	Alcoholic beverages, tobacco and narcotics
02.1.1	Spirits and liquors.
02.1.2	Wines.
02.1.3	Beer.
02.2.1	Tobacco.
02.3.1	Narcotics.
	Clothing and footwear
03.1.1	Fabrics.
03.1.2	Clothing garments.
03.1.3	Others clothing articles and products
03.1.4	Repair, cleaning and hiring of clothes.
03.2.1	Footwear.
03.2.2	Repair and hire of footwear.
	Housing, water, electricity, gas and other fuels
04.1.1	Real rents (main dwelling).
04.1.2	Real rents (secondary dwelling).
04.1.3	Other rents.
04.2.1	Rents imputed to the housing in property.
04.2.2	Other imputed rents.
04.3.1	Material for current maint. and repairs current in dwel. when undertaken by actual household
04.3.2	Current maintenance services and repairs in the dwelling.
04.4.1	Water distribution.
04.4.2	Service of withdrawal of garbage.
04.4.3	Service of sewer.
04.4.4	Other services related to the dwelling not included previously.
04.5.1	Electricity.
04.5.2	Gas.
04.5.3	Liquid fuels.

04.5.4	Solid fuels.
04.5.5	Heating and warm central water, steam and ice.
	Furnishings, household equipment and routine household maintenance
05.1.1	Furniture and furniture articles.
05.1.2	Carpets and other floor covering.
05.1.3	Repair of furniture, furniture articles and floor covering.
05.2.1	Textile articles for the household and repairs thereof.
05.3.1	Large household appliances, either electrical or not.
05.3.2	Small electrical appliances.
05.3.3	Repairs and accessories for all household equipment.
05.4.1	Glasses, crockery, cutlery, other household utensils and repairs thereof.
05.5.1	Large electric tools and repairs thereof.
05.5.2	Small tools and different accessories and repairs thereof.
05.6.1	Perishable articles for the household.
05.6.2	Household personnel and other services for the dwelling.
	Health
06.1.1	Medical products, devices and equipment.
06.2.1	Medical services.
06.2.2	Dentist services.
06.2.3	Non-hospital paramedic services.
06.3.1	Hospitable services.
	Transport
07.1.1	Automobiles.
07.1.2	Motorcycles.
07.1.3	Bicycles.
07.2.1	Purchase of spare parts and accessories of personal vehicles for repairs undertaken by household members.
07.2.2	Fuels and lubricants.
07.2.3	Maintenance and repairs.
07.2.4	Other services regarding personal vehicles.
07.3.1	Transports by rail (train, underground, tram...urban, intercity and long distance).
07.3.2	Transport by road (local and long distance).
07.3.3	Air transport.
07.3.4	Transport of travelers by sea and interior routes.
07.3.5	Other transport services.
	Communications
08.1.1	Postal services.
08.2.1	Telephone and fax equipment.
08.3.1	Telephone, telegraph and fax services
	Recreation and culture
09.1.1	Sound and image receivers, recorders and players.
09.1.2	Photographic and cinematographic equipment optical instruments.
09.1.3	Information processing material.
09.1.4	Support for recording sound and image.
09.1.5	Repairs of audiovis., photogr., and information processing equipment and accessories
09.2.1.	Other durable goods necessary for leisure and culture.
09.2.2	Musical instruments and other durables for the leisure and the culture in covered(overcast) places
09.2.3	Repair of other durable goods necessary for leisure and culture.

09.3.1	Games, toys and hobbies equipment for sport and outdoor leisure.
09.3.2	Equipment for the sport, camping and entertainment outdoors.
09.3.3	Gardening and flowers.
09.3.4	Household pets.
09.4.1	Recreational and sporting services.
09.4.2	Cultural services.
09.4.3	Gambling.
09.5.1	Books.
09.5.2	Press.
09.5.3	Other printed matter.
09.5.4	Stationery and painting materials.
09.6.1	Package holidays.
	Education
10.1.1	Infantile education.
10.1.2	Primary education.
10.2.1	secondary obligatory
10.2.2	
10.3.1	Vocational training and educations of special regime of average degree
10.4.1	Higher education
10.5.1	Education not defined by the degree
	Restaurants and hotels
11.1.1	Restaurants and cafés.
11.1.2	Canteens and cafeterias.
11.2.1	Accommodation services.
	Miscellaneous goods and services
12.1.1	Hairdressing and beauty services.
12.1.2	Devices, articles and products for personal care.
12.1.3	Other services for the elegant personnel not contemplated in another part.
12.2.1	Jewellery, imitation jewellery and watches.
12.2.2	Other personal effects.
12.3.1	Social protection services.
12.4.2	Insurance for the dwelling.
12.4.3	Insurance for health. Health and accident insurance.
12.4.4	Insurance for transport.
12.4.5	Other insurance.
12.4.6	Burial insurance.
12.5.1	Financial services not included in another part.
12.6.1	Other services not mentioned previously.
12.7.1	Money of pocket to resident minors in the dwelling.
12.8.1	Consignments to household members not resident in the dwelling.

Table A2: NACE codes for 46 economic activities in Spain and their correspondence with SIOT codes

NACE code	ECONOMIC ACTIVITY (NACE)	SIOT codes
1	Agriculture, livestock, hunting forestry	1+2
2	Fishing	3
3	Mining of coal and lignite; extraction of peat	4
4	Extraction of crude petroleum and natural gas; mining of uranium and thorium ores	5
5	Mining of metal ores	6
6	Other mining and quarrying	7
7	Manufacture of coke, refined petroleum products and nuclear fuel	8
8	production & distribution of electricity, gas & steam	9+10
9	Collection, purification and distribution of water	11
10	Food & beverages	12+13+14+15
11	Manufacture of tobacco products	16
12	Manufacture of textiles	17
13	Manufacture of wearing apparel; dressing and dyeing of fur	18
14	Manufacture of leather and leather products	19
15	Manufacture of wood and wood products	20
16	Manufacture of pulp, paper and paper products	21
17	Publishing and printing	22
18	Manufacture of chemicals and chemical products	23
19	Manufacture of rubber and plastic products	24
20	Other non ,metallic mineral products	25+26+27+28
21	Manufacture of basics metals	29
22	Manufacture of fabricated metal products	30
23	Manufacture of machinery and equipment n.e.c.	31
24	Manufacture of office machinery and computers	32
25	Manufacture of electrical machinery and apparatus n.e.c.	33
26	Manufacture of electronic equipment and apparatus	34
27	Manufacture of medical, precision and optical instruments	35
28	Manufacture of motor vehicles, trailers and semi-trailers	36
29	Manufacture of other transport equipment	37
30	Manufacture of furniture; manufacturing n.e.c.	38
31	Recycling	39
32	Construction	40
33	Vehicles & repair	41+42+43
34	Hotel & restaurant	44+45
35	Land transport	46+47
36	Water transport	48
37	Air transport	49
38	activities linked to transport	50+51
39	Post and telecommunications	52
40	Financial intermediation	53+54+55
41	Real estate & business activities	56+57+58+59+60

42	Education	61+68
43	Health & social services	62+69
44	Other social activities & services	63,64,65,66,70,71,72
45	Public Administration	67
46	Private households with employed persons	73

A.2. Total direct energy use of Spanish households

Table A3: Total direct energy use of Spanish households using expenditure data and energy intensities

COICOP	Energy product	Total Spent Euro 2005	MJ/Euro 2007	TJ
04.5.2	Natural gas and liquefied gas (butane)	3,631,149,780	69.750	253,272
04.5.3	Liquid fuels (fuel oil)	1,691,345,920	64.380	108,888
04.5.4	Solid fuel (wood, coal, peat...)	166,391,030	272.330	45,313
07.2.2	Fuels and lubricants	21,400,229,770	29.530	631,948
		Total		1,039,423

Total direct energy consumption of Spanish households according to *Environmental Accounts* (INE, 2006), 1,070,950 TJ

A.3. Matrices IOA

Table A4: Direct energy matrix (Q) for 46 NACE economic activities in Spain, as of 2005 prices

NACE code	ECONOMIC ACTIVITY (NACE)	Direct Energy (MJ/Euro)
1	**Agruculture, livestock, hunting forestry**	1,646
2	**Fishing**	14,728
3	**Mining of coal and lignite; extraction of peat**	6,052
4	**Extraction of crude petroleum and natural gas; mining of uranium and thorium ores**	1,669
5	**Mining of metal ores**	5,466
6	**Other mining and quarrying**	4,306
7	**Manufacture of coke, refined petroleum products and nuclear fuel**	3,119
8	**production & distribution of electricity, gas & steam**	22,704
9	**Collection, purification and distribution of water**	0
10	**Food & beverages**	1,471
11	**Manufacture of tobacco products**	706
12	**Manufacture of textiles**	3,638
13	**Manufacture of wearing apparel; dressing and dyeing of fur**	420
14	**Manufacture of leather and leather products**	748
15	**Manufacture of wood and wood products**	874
16	**Manufacture of pulp, paper and paper products**	6,700
17	**Publishing and printing**	510
18	**Manufacture of chemicals and chemical products**	4,213

19	Manufacture of rubber and plastic products	881
20	Other non ,metallic mineral products	8,564
21	Manufacture of basics metals	8,688
22	Manufacture of fabricated metal products	470
23	Manufacture of machinery and equipment n.e.c.	1,031
24	Manufacture of office machinery and computers	95
25	Manufacture of electrical machinery and apparatus n.e.c.	349
26	Manufacture of electronic equipment and apparatus	331
27	Manufacture of medical, precision and optical instruments	168
28	Manufacture of motor vehicles, trailers and semi-trailers	151
29	Manufacture of other transport equipment	186
30	Manufacture of furniture; manufacturing n.e.c.	304
31	Recycling	260
32	Construction	153
33	Vehicles & repair	722
34	Hotel & restaurant	874
35	Land tranport	9,356
36	Water transport	11,624
37	Air transport	15,357
38	activities linked to transport	364
39	Post and telecommunications	97
40	Financial intermediation	0
41	Real state & business activities	0
42	Education	0
43	Health & social servicies	96
44	Other social activities & servicies	12
45	Public Administration	890
46	Private households with employed persons	0

Table A5: Direct GHG emission matrix (Qemission) for 46 NACE economic activities in Spain, as of 2005 prices

NACE code	ECONOMIC ACTIVITY (NACE)	Direct GHG emissions (Kg CO2 eq/ Euro)
1	Agruculture, livestock, hunting forestry	1.248
2	Fishing	1.283
3	Mining of coal and lignite; extraction of peat	1.986
4	Extraction of crude petroleum and natural gas; mining of uranium and thorium ores	2.299
5	Mining of metal ores	1.374
6	Other mining and quarrying	0.132
7	Manufacture of coke, refined petroleum products and nuclear fuel	0.680

8	production & distribution of electricity, gas & steam	2.571
9	Collection, purification and distribution of water	0.124
10	Food & beverages	0.065
11	Manufacture of tobacco products	0.000
12	Manufacture of textiles	0.175
13	Manufacture of wearing apparel; dressing and dyeing of fur	0.019
14	Manufacture of leather and leather products	0.024
15	Manufacture of wood and wood products	0.049
16	Manufacture of pulp, paper and paper products	0.281
17	Publishing and printing	0.012
18	Manufacture of chemicals and chemical products	0.256
19	Manufacture of rubber and plastic products	0.020
20	Other non ,metallic mineral products	1.580
21	Manufacture of basics metals	0.494
22	Manufacture of fabricated metal products	0.011
23	Manufacture of machinery and equipment n.e.c.	0.021
24	Manufacture of office machinery and computers	0.004
25	Manufacture of electrical machinery and apparatus n.e.c.	0.007
26	Manufacture of electronic equipment and apparatus	0.002
27	Manufacture of medical, precision and optical instruments	0.002
28	Manufacture of motor vehicles, trailers and semi-trailers	0.004
29	Manufacture of other transport equipment	0.008
30	Manufacture of furniture; manufacturing n.e.c.	0.016
31	Recycling	0.073
32	Construction	0.011
33	Vehicles & repair	0.036
34	Hotel & restaurant	0.030
35	Land tranport	0.496
36	Water transport	1.194
37	Air transport	0.911
38	activities linked to transport	0.047
39	Post and telecommunications	0.007
40	Financial intermediation	0.004
41	Real state & business activities	0.003
42	Education	0.013
43	Health & social servicies	0.021
44	Other social activities & servicies	0.196
45	Public Administration	0.013
46	Private households with employed persons	0.000

Table A6: The 46x46 Leontief inverse matrix $(I-A)^{-1}$, as of 2005.

NACE codes	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1.129	0.015	0.010	0.005	0.007	0.004	0.005	0.003	0.004	0.386	0.198	0.075	0.037	0.065
2	0.001	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.001
3	0.002	0.003	1.008	0.011	0.004	0.010	0.009	0.065	0.004	0.004	0.002	0.004	0.003	0.004
4	0.030	0.066	0.069	1.109	0.045	0.085	0.800	0.268	0.043	0.034	0.022	0.042	0.028	0.031
5	0.002	0.003	0.004	0.007	1.008	0.004	0.005	0.003	0.004	0.002	0.002	0.002	0.002	0.002
6	0.002	0.005	0.005	0.003	0.005	1.016	0.003	0.002	0.004	0.004	0.002	0.005	0.002	0.003
7	0.041	0.102	0.082	0.101	0.062	0.114	1.301	0.158	0.059	0.043	0.027	0.052	0.034	0.038
8	0.042	0.039	0.156	0.209	0.056	0.124	0.158	1.348	0.062	0.064	0.042	0.080	0.056	0.062
9	0.010	0.004	0.003	0.002	0.003	0.007	0.003	0.004	1.002	0.008	0.003	0.005	0.004	0.004
10	0.228	0.033	0.005	0.006	0.005	0.004	0.005	0.003	0.004	1.378	0.043	0.021	0.022	0.124
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.171	0.000	0.000	0.000
12	0.003	0.041	0.005	0.008	0.004	0.004	0.006	0.003	0.005	0.007	0.005	1.404	0.530	0.072
13	0.002	0.005	0.004	0.008	0.003	0.002	0.006	0.003	0.006	0.004	0.002	0.002	1.132	0.002
14	0.000	0.005	0.005	0.002	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.001	0.010	1.342
15	0.008	0.016	0.097	0.008	0.049	0.012	0.007	0.011	0.006	0.018	0.008	0.008	0.006	0.024
16	0.012	0.008	0.011	0.017	0.015	0.011	0.014	0.010	0.018	0.039	0.060	0.026	0.019	0.024
17	0.006	0.007	0.011	0.025	0.015	0.012	0.021	0.017	0.046	0.013	0.017	0.014	0.012	0.013
18	0.075	0.042	0.120	0.063	0.195	0.107	0.050	0.032	0.151	0.072	0.031	0.232	0.106	0.103
19	0.020	0.038	0.026	0.031	0.024	0.027	0.024	0.014	0.019	0.050	0.015	0.037	0.023	0.129
20	0.007	0.006	0.014	0.011	0.012	0.014	0.009	0.008	0.010	0.026	0.007	0.011	0.007	0.008
21	0.025	0.038	0.060	0.107	0.115	0.054	0.081	0.049	0.062	0.034	0.023	0.029	0.022	0.033
22	0.048	0.045	0.074	0.154	0.133	0.086	0.117	0.072	0.068	0.059	0.038	0.038	0.028	0.049
23	0.026	0.023	0.075	0.105	0.226	0.072	0.084	0.050	0.167	0.036	0.029	0.052	0.039	0.037
24	0.002	0.003	0.003	0.006	0.006	0.004	0.005	0.004	0.004	0.003	0.003	0.005	0.003	0.003
25	0.005	0.011	0.014	0.016	0.023	0.015	0.014	0.024	0.046	0.009	0.007	0.012	0.008	0.008
26	0.001	0.006	0.003	0.004	0.004	0.003	0.004	0.004	0.005	0.003	0.002	0.004	0.003	0.003
27	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.001	0.001	0.001	0.001
28	0.008	0.012	0.007	0.012	0.009	0.010	0.010	0.006	0.008	0.011	0.005	0.011	0.011	0.012
29	0.001	0.107	0.010	0.002	0.015	0.005	0.002	0.002	0.001	0.004	0.002	0.003	0.002	0.003
30	0.002	0.004	0.004	0.007	0.007	0.006	0.006	0.005	0.005	0.004	0.006	0.005	0.005	0.004
31	0.004	0.006	0.010	0.018	0.019	0.009	0.013	0.008	0.010	0.006	0.004	0.005	0.004	0.006
32	0.028	0.025	0.036	0.074	0.066	0.058	0.063	0.060	0.067	0.052	0.048	0.048	0.037	0.041
33	0.100	0.073	0.058	0.128	0.080	0.089	0.107	0.072	0.094	0.122	0.047	0.123	0.142	0.151
34	0.005	0.011	0.007	0.015	0.009	0.012	0.014	0.008	0.007	0.009	0.009	0.009	0.008	0.010
35	0.033	0.034	0.046	0.033	0.092	0.093	0.047	0.027	0.029	0.096	0.059	0.088	0.070	0.075
36	0.002	0.002	0.002	0.004	0.002	0.002	0.004	0.002	0.002	0.003	0.005	0.004	0.003	0.004
37	0.002	0.006	0.005	0.011	0.005	0.006	0.009	0.005	0.003	0.004	0.005	0.005	0.005	0.004
38	0.026	0.111	0.043	0.036	0.065	0.107	0.046	0.023	0.040	0.057	0.040	0.058	0.049	0.045
39	0.015	0.029	0.046	0.047	0.038	0.039	0.040	0.057	0.037	0.035	0.027	0.056	0.042	0.034
40	0.036	0.056	0.040	0.082	0.059	0.042	0.076	0.058	0.043	0.054	0.042	0.059	0.052	0.056
41	0.097	0.124	0.180	0.580	0.308	0.212	0.465	0.279	0.248	0.235	0.264	0.245	0.225	0.251
42	0.003	0.004	0.005	0.019	0.009	0.004	0.015	0.008	0.006	0.006	0.009	0.007	0.007	0.005
43	0.009	0.004	0.003	0.004	0.004	0.003	0.003	0.003	0.003	0.007	0.004	0.006	0.003	0.003
44	0.007	0.009	0.009	0.021	0.014	0.012	0.020	0.013	0.015	0.016	0.028	0.016	0.013	0.013
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	0.118	0.074	0.015	0.012	0.026	0.005	0.008	0.005	0.005	0.006	0.007	0.007	0.005	0.008	0.007
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.004	0.007	0.004	0.006	0.006	0.007	0.020	0.009	0.006	0.005	0.009	0.006	0.004	0.007	0.006
4	0.044	0.050	0.027	0.118	0.057	0.056	0.052	0.037	0.030	0.025	0.041	0.033	0.024	0.035	0.032
5	0.003	0.003	0.005	0.004	0.004	0.005	0.080	0.030	0.017	0.011	0.024	0.014	0.007	0.019	0.014
6	0.003	0.005	0.003	0.020	0.006	0.067	0.017	0.008	0.005	0.005	0.008	0.006	0.005	0.006	0.005
7	0.056	0.054	0.030	0.176	0.072	0.068	0.063	0.043	0.035	0.029	0.048	0.039	0.028	0.041	0.040
8	0.077	0.130	0.064	0.093	0.098	0.110	0.106	0.081	0.064	0.056	0.089	0.072	0.056	0.080	0.065
9	0.004	0.004	0.003	0.004	0.004	0.004	0.002	0.003	0.002	0.004	0.002	0.003	0.002	0.003	0.003
10	0.027	0.023	0.007	0.015	0.010	0.004	0.006	0.004	0.004	0.004	0.005	0.005	0.004	0.005	0.005
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.007	0.024	0.007	0.011	0.032	0.005	0.007	0.005	0.006	0.010	0.008	0.007	0.010	0.031	0.012
13	0.003	0.004	0.003	0.004	0.004	0.004	0.006	0.004	0.005	0.013	0.005	0.004	0.003	0.006	0.004
14	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
15	1.492	0.067	0.015	0.009	0.011	0.016	0.019	0.018	0.012	0.011	0.021	0.018	0.012	0.012	0.016
16	0.034	1.304	0.218	0.028	0.026	0.020	0.057	0.028	0.021	0.029	0.031	0.028	0.023	0.023	0.021
17	0.012	0.012	1.094	0.020	0.017	0.013	0.012	0.011	0.011	0.020	0.015	0.016	0.014	0.015	0.015
18	0.094	0.148	0.074	1.427	0.325	0.085	0.132	0.092	0.070	0.071	0.136	0.104	0.066	0.102	0.100
19	0.029	0.029	0.026	0.052	1.306	0.025	0.026	0.028	0.047	0.057	0.113	0.095	0.065	0.132	0.123
20	0.010	0.009	0.006	0.016	0.011	1.133	0.017	0.017	0.017	0.025	0.020	0.035	0.035	0.025	0.016
21	0.038	0.035	0.076	0.036	0.056	0.067	1.237	0.452	0.255	0.160	0.357	0.209	0.112	0.282	0.217
22	0.061	0.053	0.037	0.043	0.055	0.073	0.244	1.192	0.233	0.110	0.184	0.133	0.083	0.148	0.167
23	0.054	0.052	0.038	0.062	0.056	0.089	0.095	0.079	1.156	0.030	0.087	0.061	0.039	0.065	0.093
24	0.003	0.006	0.004	0.005	0.003	0.005	0.006	0.010	0.009	1.400	0.004	0.006	0.030	0.005	0.006
25	0.010	0.011	0.008	0.013	0.013	0.016	0.016	0.014	0.091	0.084	1.262	0.267	0.172	0.064	0.059
26	0.002	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.005	0.088	0.019	1.458	0.241	0.009	0.043
27	0.001	0.001	0.001	0.003	0.001	0.001	0.001	0.001	0.001	0.007	0.002	0.087	1.066	0.003	0.006
28	0.013	0.011	0.008	0.009	0.009	0.012	0.014	0.011	0.009	0.016	0.010	0.011	0.011	1.688	0.060
29	0.003	0.003	0.002	0.003	0.003	0.004	0.005	0.003	0.003	0.002	0.003	0.003	0.002	0.003	1.194
30	0.003	0.005	0.005	0.006	0.005	0.005	0.006	0.005	0.008	0.014	0.005	0.008	0.006	0.007	0.007
31	0.007	0.021	0.015	0.006	0.010	0.011	0.201	0.074	0.042	0.026	0.058	0.034	0.018	0.046	0.036
32	0.034	0.052	0.038	0.051	0.042	0.052	0.047	0.042	0.038	0.041	0.040	0.043	0.043	0.043	0.039
33	0.160	0.119	0.084	0.081	0.096	0.097	0.115	0.103	0.097	0.231	0.100	0.128	0.137	0.110	0.093
34	0.008	0.010	0.008	0.017	0.012	0.011	0.012	0.010	0.008	0.007	0.010	0.010	0.007	0.010	0.011
35	0.097	0.098	0.065	0.076	0.074	0.142	0.089	0.071	0.058	0.042	0.069	0.067	0.048	0.069	0.054
36	0.006	0.003	0.002	0.005	0.003	0.002	0.003	0.003	0.002	0.001	0.003	0.002	0.001	0.003	0.002
37	0.004	0.005	0.004	0.008	0.006	0.006	0.006	0.005	0.004	0.004	0.006	0.006	0.006	0.005	0.005
38	0.047	0.063	0.047	0.063	0.061	0.088	0.086	0.062	0.047	0.038	0.059	0.053	0.041	0.060	0.051
39	0.028	0.033	0.035	0.048	0.033	0.035	0.031	0.026	0.028	0.032	0.031	0.032	0.032	0.029	0.025
40	0.043	0.050	0.041	0.054	0.053	0.046	0.052	0.047	0.046	0.049	0.050	0.051	0.044	0.053	0.048
41	0.175	0.234	0.213	0.310	0.259	0.228	0.205	0.202	0.206	0.220	0.237	0.281	0.260	0.247	0.259
42	0.005	0.005	0.006	0.009	0.007	0.005	0.011	0.007	0.005	0.006	0.006	0.007	0.004	0.007	0.006
43	0.005	0.003	0.003	0.005	0.004	0.003	0.003	0.002	0.002	0.002	0.003	0.002	0.003	0.004	0.003
44	0.011	0.014	0.067	0.020	0.018	0.013	0.012	0.011	0.010	0.011	0.012	0.014	0.014	0.018	0.016
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
1	0.023	0.020	0.005	0.007	0.078	0.004	0.017	0.005	0.010	0.004	0.002	0.004	0.004	0.008	0.016
2	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
3	0.004	0.008	0.003	0.003	0.002	0.003	0.004	0.003	0.003	0.003	0.001	0.002	0.001	0.002	0.002
4	0.029	0.039	0.022	0.022	0.018	0.092	0.150	0.187	0.048	0.020	0.008	0.011	0.010	0.019	0.017
5	0.009	0.021	0.005	0.002	0.001	0.002	0.002	0.002	0.002	0.002	0.000	0.001	0.000	0.001	0.001
6	0.004	0.007	0.019	0.001	0.002	0.001	0.002	0.002	0.002	0.003	0.001	0.002	0.001	0.002	0.002
7	0.036	0.045	0.027	0.024	0.023	0.133	0.233	0.300	0.068	0.021	0.009	0.012	0.012	0.026	0.020
8	0.054	0.091	0.040	0.056	0.030	0.045	0.073	0.056	0.044	0.058	0.016	0.025	0.021	0.027	0.034
9	0.002	0.003	0.002	0.004	0.004	0.008	0.006	0.002	0.003	0.002	0.001	0.002	0.002	0.003	0.007
10	0.008	0.009	0.003	0.005	0.234	0.006	0.041	0.008	0.022	0.003	0.003	0.003	0.008	0.019	0.015
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.043	0.012	0.005	0.006	0.013	0.004	0.009	0.010	0.006	0.007	0.001	0.004	0.002	0.007	0.010
13	0.005	0.007	0.005	0.003	0.004	0.002	0.004	0.014	0.003	0.010	0.001	0.004	0.001	0.004	0.013
14	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.001	0.000	0.002	0.000	0.000	0.000	0.000	0.001
15	0.204	0.035	0.032	0.005	0.012	0.006	0.009	0.007	0.018	0.007	0.003	0.007	0.003	0.003	0.014
16	0.030	0.268	0.011	0.008	0.012	0.007	0.010	0.010	0.010	0.015	0.010	0.017	0.007	0.008	0.015
17	0.011	0.012	0.010	0.015	0.010	0.012	0.016	0.016	0.016	0.013	0.016	0.044	0.010	0.012	0.038
18	0.090	0.104	0.046	0.020	0.038	0.022	0.033	0.026	0.038	0.022	0.007	0.019	0.007	0.099	0.036
19	0.074	0.037	0.029	0.014	0.015	0.022	0.019	0.016	0.029	0.015	0.003	0.008	0.003	0.011	0.018
20	0.012	0.022	0.146	0.007	0.010	0.007	0.008	0.008	0.011	0.020	0.004	0.012	0.004	0.007	0.009
21	0.134	0.312	0.079	0.022	0.016	0.026	0.032	0.034	0.025	0.032	0.007	0.016	0.007	0.013	0.021
22	0.127	0.639	0.109	0.021	0.022	0.028	0.039	0.041	0.028	0.027	0.007	0.018	0.008	0.013	0.025
23	0.047	0.077	0.047	0.015	0.018	0.022	0.029	0.031	0.024	0.033	0.005	0.011	0.006	0.011	0.020
24	0.004	0.013	0.003	0.003	0.003	0.003	0.007	0.005	0.006	0.028	0.004	0.007	0.003	0.003	0.006
25	0.021	0.017	0.048	0.008	0.009	0.008	0.011	0.010	0.012	0.042	0.004	0.008	0.004	0.011	0.010
26	0.011	0.004	0.011	0.004	0.003	0.004	0.005	0.006	0.006	0.043	0.003	0.005	0.003	0.011	0.008
27	0.001	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.004	0.000	0.001	0.002	0.038	0.002
28	0.015	0.033	0.008	0.066	0.007	0.033	0.010	0.008	0.018	0.005	0.001	0.005	0.001	0.005	0.005
29	0.003	0.006	0.002	0.002	0.002	0.025	0.039	0.040	0.014	0.002	0.001	0.001	0.001	0.001	0.001
30	1.071	0.010	0.013	0.005	0.011	0.006	0.009	0.010	0.019	0.011	0.004	0.011	0.006	0.004	0.026
31	0.022	1.068	0.014	0.004	0.003	0.004	0.005	0.006	0.004	0.005	0.001	0.003	0.001	0.002	0.004
32	0.035	0.070	1.584	0.051	0.042	0.045	0.056	0.056	0.089	0.068	0.038	0.112	0.029	0.032	0.059
33	0.132	0.145	0.094	1.066	0.081	0.109	0.057	0.048	0.058	0.051	0.014	0.033	0.017	0.059	0.057
34	0.008	0.012	0.006	0.008	1.004	0.020	0.030	0.024	0.088	0.007	0.011	0.008	0.006	0.011	0.014
35	0.071	0.072	0.048	0.051	0.026	1.054	0.081	0.044	0.172	0.021	0.007	0.014	0.006	0.016	0.021
36	0.002	0.003	0.001	0.002	0.001	0.003	1.004	0.003	0.009	0.001	0.000	0.001	0.000	0.001	0.001
37	0.004	0.006	0.003	0.004	0.002	0.009	0.015	1.080	0.042	0.003	0.008	0.003	0.001	0.003	0.005
38	0.049	0.071	0.033	0.049	0.019	0.236	0.352	0.187	1.284	0.023	0.008	0.015	0.005	0.013	0.018
39	0.028	0.028	0.024	0.032	0.029	0.025	0.032	0.054	0.034	1.231	0.035	0.043	0.014	0.022	0.034
40	0.043	0.053	0.041	0.049	0.038	0.051	0.050	0.063	0.042	0.038	1.245	0.064	0.012	0.024	0.033
41	0.203	0.220	0.159	0.248	0.150	0.191	0.272	0.333	0.188	0.262	0.147	1.142	0.059	0.137	0.171
42	0.004	0.006	0.003	0.003	0.003	0.004	0.005	0.005	0.003	0.004	0.001	0.002	1.003	0.003	0.002
43	0.004	0.003	0.002	0.006	0.004	0.003	0.003	0.002	0.002	0.007	0.002	0.003	0.001	1.050	0.004
44	0.012	0.013	0.008	0.014	0.015	0.011	0.016	0.017	0.014	0.016	0.010	0.037	0.004	0.015	1.158
45	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	45	46
1	0.006	0.000
2	0.000	0.000
3	0.003	0.000
4	0.016	0.000
5	0.001	0.000
6	0.001	0.000
7	0.017	0.000
8	0.042	0.000
9	0.003	0.000
10	0.009	0.000
11	0.000	0.000
12	0.004	0.000
13	0.002	0.000
14	0.001	0.000
15	0.003	0.000
16	0.013	0.000
17	0.018	0.000
18	0.015	0.000
19	0.007	0.000
20	0.004	0.000
21	0.016	0.000
22	0.016	0.000
23	0.020	0.000
24	0.003	0.000
25	0.006	0.000
26	0.004	0.000
27	0.001	0.000
28	0.008	0.000
29	0.025	0.000
30	0.005	0.000
31	0.003	0.000
32	0.032	0.000
33	0.042	0.000
34	0.009	0.000
35	0.018	0.000
36	0.001	0.000
37	0.008	0.000
38	0.012	0.000
39	0.043	0.000
40	0.026	0.000
41	0.137	0.000
42	0.002	0.000
43	0.003	0.000
44	0.009	0.000
45	1.000	0.000
46	0.000	1.000

Table A7: Matrix of transformation coefficients (H) for 46 NACE economic activities and 116 COICOP products.

	1	2	3	4	5	6	7	8	9	10
COICOP PRODUCTS ⇨ ECONOMIC ACTIVITY ⇩	**01.1.1**	**01.1.2**	**01.1.3**	**01.1.4**	**01.1.5**	**01.1.6**	**01.1.7**	**01.1.8**	**01.1.9**	**01.2.1**
1	0.37	0.66	0	0.53	0	0.53	0.53	0	0.42	0.5
2	0	0	0.62	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0.63	0.34	0.38	0.47	1	0.47	0.47	1	0.58	0.5
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	11	12	13	14	15	16	17	18	19	20	21	22
	01.2.2	**02.1.1**	**02.1.2**	**02.1.3**	**02.2.1**	**02.3.1**	**03.1.1**	**03.1.2**	**03.1.3**	**03.1.4**	**03.2.1**	**03.2.2**
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	1	1	1	1	0	0	0	0	0	0	0	0
11	0	0	0	0	1	0	0	0	0	0	0	0
12	0	0	0	0	0	0	1	0	0.5	0	0	0
13	0	0	0	0	0	0	0	1	0.5	0	0	0
14	0	0	0	0	0	0	0	0	0	0	1	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0.7	0	0.8
34	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0.3	0	0.2
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	23	24	25	26	27	28	29	30	31	32	33	34
	04.1.1	**04.1.2**	**04.1.3**	**04.2.1**	**04.2.2**	**04.3.1**	**04.3.2**	**04.4.1**	**04.4.2**	**04.4.3**	**04.4.4**	**04.5.1**
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	1
9	0	0	0	0	0	0	0	1	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0.25	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0.25	0	0	0	0	0	0
19	0	0	0	0	0	0.25	0	0	0	0	0	0
20	0	0	0	0	0	0.25	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	1	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	1	1	1	1	1	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	1	1	1	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	35	36	37	38	39	40	41	42	43	44	45	46
	04.5.2	**04.5.3**	**04.5.4**	**04.5.5**	**05.1.1**	**05.1.2**	**05.1.3**	**05.2.1**	**05.3.1**	**05.3.2**	**05.3.3**	**05.4.1***
1	0	0	0.45	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0.21	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0.51	1	0.34	0	0	0	0	0	0	0	0	0
8	0.49	0	0	1	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	1	0	1	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0.20
20	0	0	0	0	0	0	0	0	0	0	0	0.20
21	0	0	0	0	0	0	0	0	0	0	0	0.20
22	0	0	0	0	0	0	0	0	0	0	0	0.20
23	0	0	0	0	0	0	0	0	1	1	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	1	0	1	0	0	0	0	0.2
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	1	0
34	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	47	48	49	50	51	52	53	54	55	56	57	58
	05.5.1*	**05.5.2***	**05.6.1***	**05.6.2**	**06.1.1***	**06.2.1**	**06.2.2**	**06.2.3**	**06.3.1**	**07.1.1**	**07.1.2**	**07.1.3**
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0.20	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0.20	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0.20	0	0.75	0	0	0	0	0	0	0
19	0	0.20	0.20	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0.20	0	0	0	0	0	0	0	0	0	0
23	0.50	0.20	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0.5	0.2	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0.25	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	1	0	0
29	0	0	0	0	0	0	0	0	0	0	1	1
30	0	0	0.2	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0.2	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0.07	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	1	1	1	1	0	0	0
44	0	0	0	0.07	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0.85	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	59	60	61	62	63	64	65	66	67	68	69	70
	07.2.1*	**07.2.2***	**07.2.3**	**07.2.4***	**07.3.1**	**07.3.2**	**07.3.3**	**07.3.4**	**07.3.5**	**07.3.6**	**08.1.1**	**08.2.1***
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0.75	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0.25	0	0	0	0	0	0	0	0	0	0
19	0.20	0	0	0	0	0	0	0	0	0	0	0
20	0.20	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0.20	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0.20	0	0	0	0	0	0	0	0	0	0	0
26	0.20	0	0	0	0	0	0	0	0	0	0	0.90
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	1	0	0	0	0	0	0	0	0	0.10
34	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	1	1	0	0	1	0	0	0
36	0	0	0	0	0	0	0	1	0	0	0	0
37	0	0	0	0	0	0	1	0	0	0	0	0
38	0	0	0	0.75	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	1	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0.25	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	71	72	73	74	75	76	77	78	79	80	81	82
	08.3.1	**09.1.1**	**09.1.2***	**09.1.3***	**09.1.4***	**09.1.5***	**09.2.1***	**09.2.2**	**09.2.3***	**09.3.1***	**09.3.2***	**09.3.3***
1	0	0	0	0	0	0	0	0	0	0	0	0.6
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0.13	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0.13	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0.3	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0.33	0	0.14	0	0	0.1	0	0.4
19	0	0	0	0	0	0	0	0	0	0	0.13	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0.13	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0.33	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0.14	0	0	0	0.13	0
26	0	1.00	0.50	0.33	0	0	0	0	0	0	0.13	0
27	0	0	0.50	0	0	0	0.14	0	0	0	0	0
28	0	0	0	0	0	0	0.14	0	0	0	0	0
29	0	0	0	0	0	0	0.14	0	0	0	0	0
30	0	0	0	0	0	0	0.14	1	0.33	0.6	0.13	0
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0.30	0.14	0	0.33	0	0.13	0
34	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0.33	0	0	0
39	1	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0.33	0.33	0.70	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0.33	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	83	84	85	86	87	88	89	90	91	92	93	94
	09.3.4*	**09.4.1**	**09.4.2**	**09.4.3**	**09.5.1**	**09.5.2**	**09.5.3**	**09.5.4***	**09.6.1**	**10.1.1**	**10.1.2**	**10.2.1**
1	0.33	0	0	0	0	0	0	0	0	0	0	0
2	0.33	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0.25	0	0	0	0
17	0	0	0	0	0.9	1	1	0	0	0	0	0
18	0.33	0	0	0	0	0	0	0.25	0	0	0	0
19	0	0	0	0	0	0	0	0.25	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0.25	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0.25	0	0	0	0	0	0	1	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0.25	0.50	0	0	0	0	0	0	0	0	0
42	0	0.25	0	0	0	0	0	0	0	1	1	1
43	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0.25	0.50	1	0.10	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	95	96	97	98	99	100	101	102	103	104	105	106
	10.2.2	**10.3.1**	**10.4.1**	**10.5.1**	**11.1.1**	**11.1.2**	**11.2.1**	**12.1.1**	**12.1.2***	**12.1.3***	**12.2.1***	**12.2.2***
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0.14
15	0	0	0	0	0	0	0	0	0	0	0	0.14
16	0	0	0	0	0	0	0	0	0	0.20	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0.40	0	0
19	0	0	0	0	0	0	0	0	0	0.20	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0.14
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0.14
23	0	0	0	0	0	0	0	0	0.90	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0.50	0.14
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0.20	0.40	0.14
31	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0.10	0	0.10	0.14
34	0	0	0	0	1	1	1	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0
42	1	1	1	1	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	1	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

	107	108	109	110	111	112	113	114	115	116
	12.3.1	**12.4.2**	**12.4.3**	**12.4.4**	**12.4.5**	**12.4.6**	**12.5.1**	**12.6.1***	**12.7.1**	**12.8.1**
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	1	0	0	0
40	0	1	1	1	1	1	0	0	0	0
41	0	0	0	0	0	0	0	0.50	0	0
42	0	0	0	0	0	0	0	0	0	0
43	1	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0.50	0	0
45	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0

* Products that have been distributed into their respective production branches by making simple assumptions, for example, a homogeneous distribution.

A.4. Results

Table A8: Average and marginal expenditure shares with energy intensities and CO_2-eq intensities for 116 goods and services in Spain, 2007.

Code	COICOP PRODUCTS	Expenditure share (%)		Energy intensity	CO_2-eq intensity
		Average	Marginal	MJ/Euro	gCO_2-eq/Euro
	Food and non-alcoholic beverages				
01.1.1	Bread and cereals.	2.28	0.67	6.77	1,033
01.1.2	Meat.	3.63	1.64	6.73	1,045
01.1.3	Fish.	1.89	1.06	7.22	1,050
01.1.4	Milk, cheese and eggs.	1.84	0.56	6.54	1,106
01.1.5	Oils and fats.	0.42	0.18	6.80	1,022
01.1.6	Fruits.	1.38	0.51	6.47	1,126
01.1.7	Vegetables including potatoes and other tubers.	1.40	0.59	6.36	1,161
01.1.8	Sugar, jams, honey, chocolate, sweets and ice creams.	0.60	0.28	6.80	1,022
01.1.9	Nourishing products not included previously.	0.41	0.21	6.76	1,036
01.2.1	Coffee, tea, cocoa.	0.21	0.08	6.78	1,029
01.2	Mineral waters, fizzy beverages and juices.	0.69	0.26	6.80	1,022
	Alcoholic beverages, tobacco and narcotics				
02.1.1	Spirits and liquors.	0.10	0.07	6.80	1,022
02.1.2	Wines.	0.26	0.26	6.80	1,022
02.1.3	Beer.	0.19	0.08	6.80	1,022
02.2.1	Tobacco.	1.25	0.45	3.95	533
02.3.1	Narcotics.	0.00	0.00*	0.00	0
	Clothing and footwear				
03.1.1	Fabrics.	0.06	0.06	10.07	858
03.1.2	Clothing garments.	4.98	6.72	5.79	515
03.1.3	Others clothing articles and products	0.14	0.24	7.93	686
03.1.4	Repair, cleaning and hiring of clothes.	0.05	0.08	2.87	373
03.2.1	Footwear.	1.51	1.63	5.30	528
03.2.2	Repair and hire of footwear.	0.02	0.02	3.01	361
	Housing, water, electricity, gas and other fuels				
04.1.1	Real rents (main dwelling).	1.25	-0.76	1.40	170
04.1.2	Real rents (secondary dwelling).	0.08	0.11	1.40	170
04.1.3	Other rents.	0.13	0.11	1.40	170
04.2.1	Rents imputed to the housing in property.	17.28	8.55	1.40	170
04.2.2	Other imputed rents.	0.79	0.03*	1.40	170
04.3.1	Material for current maint. and repairs current in dwel. when undertaken by actual household	0.33	0.44	9.93	1,255
04.3.2	Current maintenance services and repairs in the dwelling.	0.80	1.79	4.42	538
04.4.1	Water distribution.	0.45	0.12	3.86	570
04.4.2	Service of withdrawal of garbage.	0.22	0.07	1.96	458
04.4.3	Service of sewer.	0.11	0.03	1.96	458
04.4.4	Other services related to the dwelling not included previously.	1.13	0.66	1.96	458
04.5.1	Electricity.	1.52	0.46	33.25	4,408
04.5.2	Gas.	0.69	0.25	91.73	7,005

04.5.3	Liquid fuels.	0.43	0.27	75.52	7,343
04.5.4	Solid fuels.	0.04	0.01	280.7	8,901
04.5.5	Heating and warm central water, steam and ice.	0.00	0.00*	33.25	4,408
	Furnishings, household equipment and routine household maintenance				
05.1.1	Furniture and furniture articles.	1.50	2.86	5.12	490
05.1.2	Carpets and other floor covering.	0.06	0.17	10.07	858
05.1.3	Repair of furniture, furniture articles and floor covering.	0.04	0.12	5.12	490
05.2.1	Textile articles for the household and repairs thereof.	0.63	0.82	10.07	858
05.3.1	Large household appliances, either electrical or not.	0.77	0.80	6.73	553
05.3.2	Small electrical appliances.	0.11	0.13	6.73	553
05.3.3	Repairs and accessories for all household equipment.	0.18	0.21	3.27	337
05.4.1	Glasses, crockery, cutlery, other household utensils and repairs thereof.	0.28	0.47	10.64	1,153
05.5.1	Large electric tools and repairs thereof.	0.04	0.04	7.47	647
05.5.2	Small tools and different accessories and repairs thereof.	0.20	0.25	6.78	618
05.6.1	Perishable articles for the household.	0.84	0.46	9.56	865
05.6.2	Household personnel and other services for the dwelling.	1.16	2.61	0.25	46
	Health				
06.1.1	Medical products, devices and equipment.	1.28	1.22	9.27	971
06.2.1	Medical services.	0.17	0.17	1.89	237
06.2.2	Dentist services.	1.34	2.66	1.89	237
06.2.3	Non-hospital paramedic services.	0.11	0.19	1.89	237
06.3.1	Hospitable services.	0.19	1.35	1.89	237
	Transport				
07.1.1	Automobiles.	5.45	15.98	7.01	655
07.1.2	Motorcycles.	0.27	0.43	5.72	539
07.1.3	Bicycles.	0.05	0.04	5.72	539
07.2.1	Purchase of spare parts and accessories of personal vehicles for repairs undertaken by household members.	0.34	0.47	8.85	1,007
07.2.2	Fuels and lubricants.	4.32	3.40	40.61	5,176
07.2.3	Maintenance and repairs.	2.08	3.53	3.27	337
07.2.4	Other services regarding personal vehicles.	0.50	0.71	4.10	449
07.3.1	Transports by rail (train, underground, tram...urban, intercity and long distance).	0.19	0.14	12.39	1,019
07.3.2	Transport by road (local and long distance).	0.43	0.23	12.39	1,019
07.3.3	Air transport.	0.29	0.27	20.42	1,864
07.3.4	Transport of travelers by sea and interior routes.	0.05	0.09	16.32	2,049
07.3.5	Other transport services.	0.13	0.02*	12.39	1,019
	Communications				
08.1.1	Postal services.	0.03	0.03	2.68	316
08.2.1	Telephone and fax equipment.	0.06	0.04	6.13	564
08.3.1	Telephone, telegraph and fax services	2.74	1.23	2.68	316
	Recreation and culture				
09.1.1	Sound and image receivers, recorders and players.	0.37	0.39	6.45	589
09.1.2	Photographic and cinematographic equipment optical instruments.	0.11	0.09	5.42	510
09.1.3	Information processing material.	0.36	0.27	4.18	403
09.1.4	Support for recording sound and image.	0.18	0.16	4.75	593
09.1.5	Repairs of audiovis., photogr., and information processing equipment and accessories	0.09	0.13	1.96	220

09.2.1	Other durable goods necessary for leisure and culture.	0.09	0.48	6.37	621
09.2.2	Musical instruments and other durables for the leisure and the culture in covered(overcast) places	0.04	0.04	5.12	490
09.2.3	Repair of other durable goods necessary for leisure and culture.	0.01	0.00*	4.47	456
09.3.1	Games, toys and hobbies equipment for sport and outdoor leisure.	0.52	0.89	8.55	743
09.3.2	Equipment for the sport, camping and entertainment outdoors.	0.14	0.21	6.76	625
09.3.3	Gardening and flowers.	0.22	0.35	7.12	1,490
09.3.4	Household pets.	0.22	0.24	11.03	1,530
09.4.1	Recreational and sporting services.	0.64	0.97	2.30	324
09.4.2	Cultural services.	0.88	1.19	1.68	314
09.4.3	Gambling.	0.63	0.56	1.96	458
09.5.1	Books.	0.51	0.40	5.28	482
09.5.2	Press.	0.42	0.27	5.65	485
09.5.3	Other printed matter.	0.01	0.01	5.65	485
09.5.4	Stationery and painting materials.	0.17	0.13	9.44	866
09.6.1	Package holidays.	1.37	1.77	5.01	542
	Education				
10.1.1	Infantile education.	0.12	0.10	0.84	125
10.1.2	Primary education.	0.11	0.18	0.84	125
10.2.1	secondary obligatory	0.08	0.16	0.84	125
10.2.2		0.06	0.19	0.84	125
10.3.1	Vocational training and educations of special regime of average degree	0.02	0.00*	0.84	125
10.4.1	Higher education	0.33	0.48	0.84	125
10.5.1	Education not defined by the degree	0.21	0.23	0.84	125
	Restaurants and hotels				
11.1.1	Restaurants and cafés.	9.06	9.45	3.16	352
11.1.2	Canteens and cafeterias.	0.28	0.17	3.16	352
11.2.1	Accommodation services.	0.69	1.03	3.16	352
	Miscellaneous goods and services				
12.1.1	Hairdressing and beauty services.	1.10	0.92	1.96	458
12.1.2	Devices, articles and products for personal care.	1.45	1.17	6.39	531
12.1.3	Other services for the elegant personnel not contemplated in another part.	0.00	0.00*	9.73	923
12.2.1	Jewellery, imitation jewellery and watches.	0.52	1.64	4.58	445
12.2.2	Other personal effects.	0.37	0.53	6.91	813
12.3.1	Social protection services.	0.23	0.27	1.89	237
12.4.2	Insurance for the dwelling.	0.55	0.33	0.88	107
12.4.3	Insurance for health. Health and accident insurance.	0.44	0.55	0.88	107
12.4.4	Insurance for transport.	1.64	1.01	0.88	107
12.4.5	Other insurance.	0.01	0.01	0.88	107
12.4.6	Burial insurance.	0.33	-0.01*	0.88	107
12.5.1	Financial services not included in another part.	0.01	0.00	2.68	316
12.6.1	Other services not mentioned previously.	0.79	3.70	1.68	314
12.7.1	Money of pocket to resident minors in the dwelling.	0.07	0.04	0.00	0
12.8.1	Consignments to household members not resident in the dwelling.	0.12	0.35	0.00	0

* Significance level >0.1

A.5. Comparison between Spain and Sweden in terms of energy use and GHG emissions

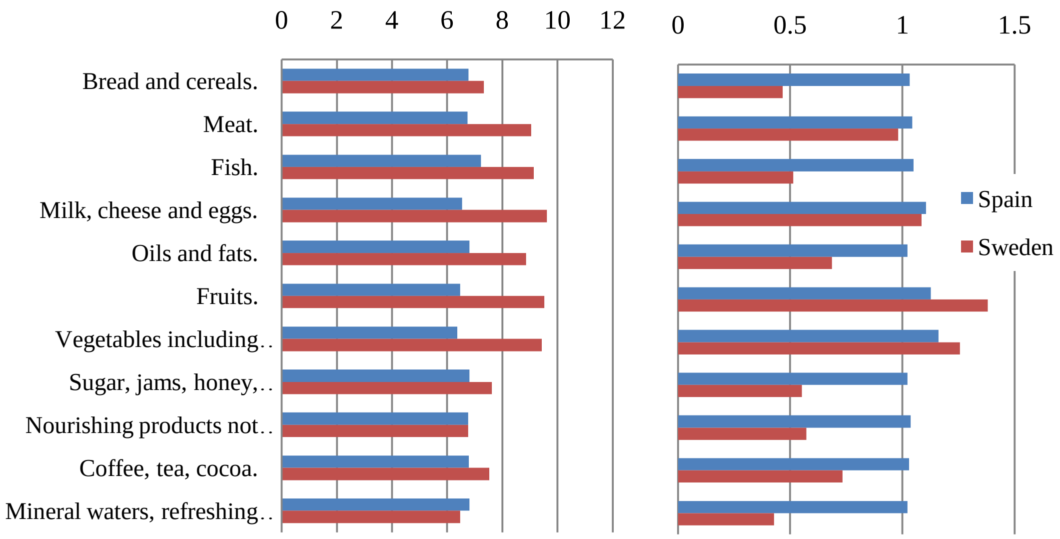

Figure A1: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for food and non- alcoholic beverage products and services in Spain and Sweden.

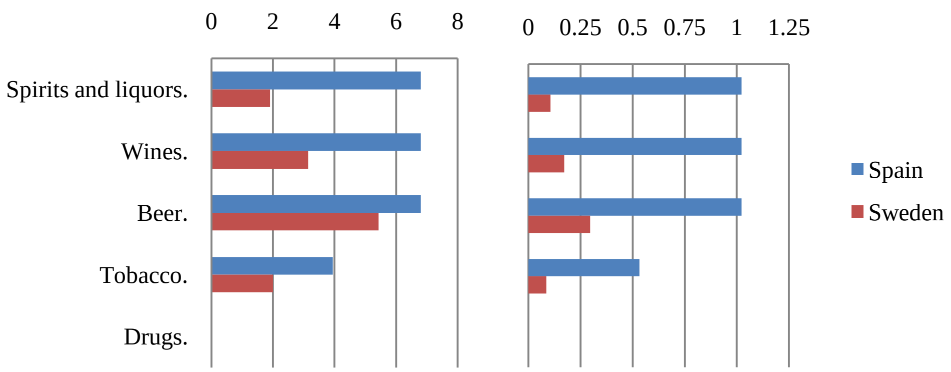

Figure A2: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for alcoholic beverage, tobacco and narcotic products and services in Spain and Sweden.

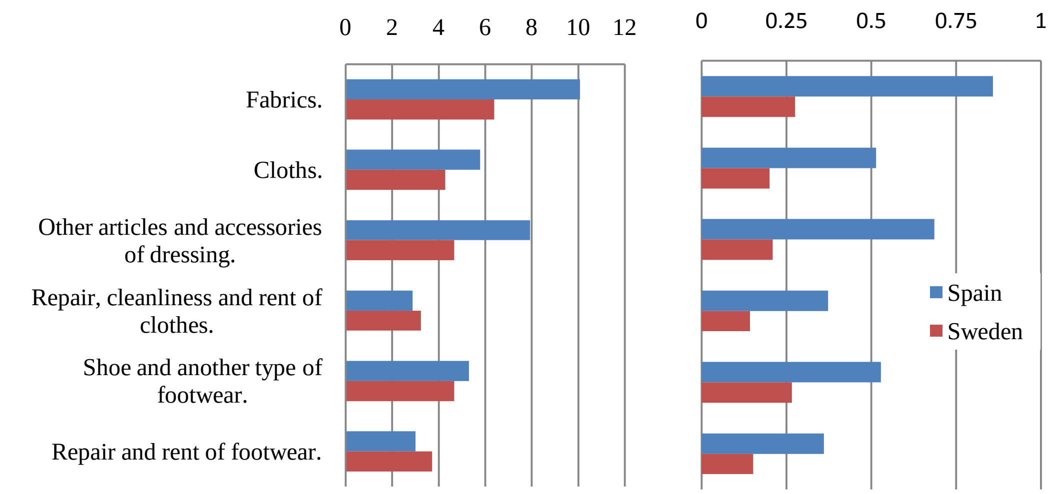

Figure A3: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for clothing and footwear products and services in Spain and Sweden.

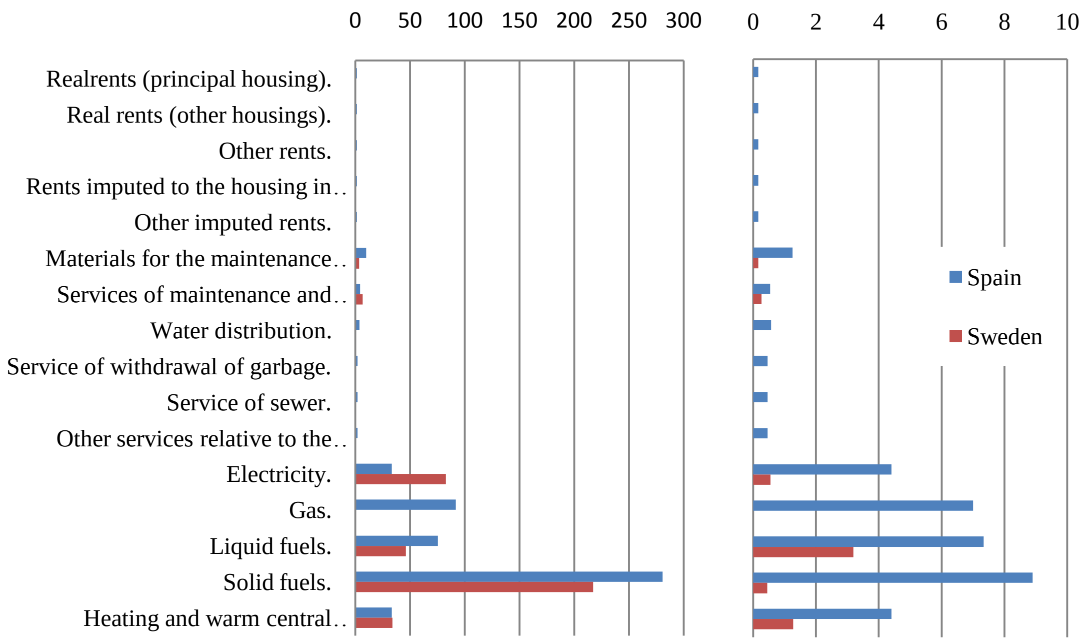

Figure A4: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for housing, electricity, gas and other fuel products and services in Spain and Sweden.

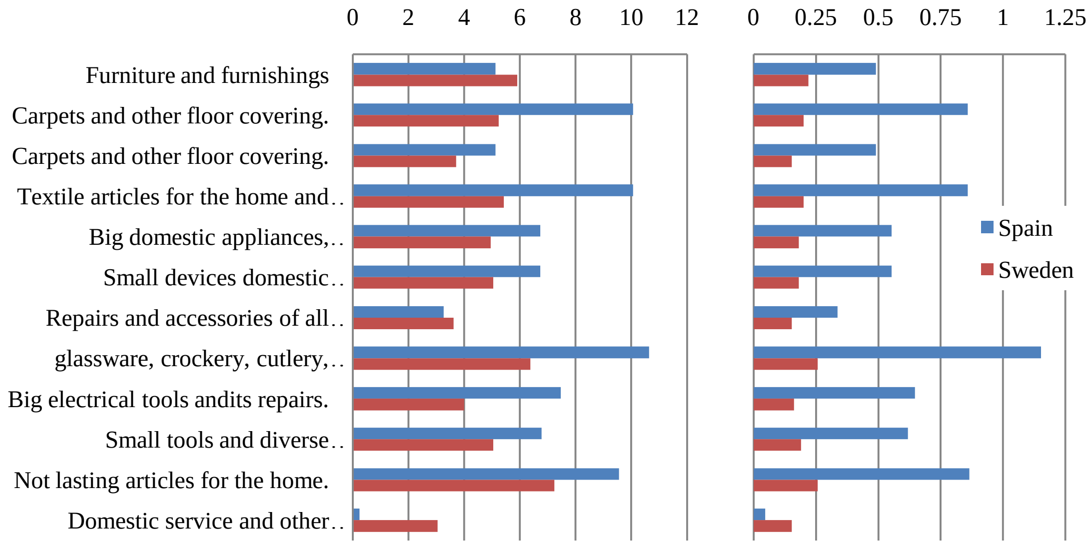

Figure A5: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for furnishings, household equipment and routine household maintenance products and services in Spain and Sweden.

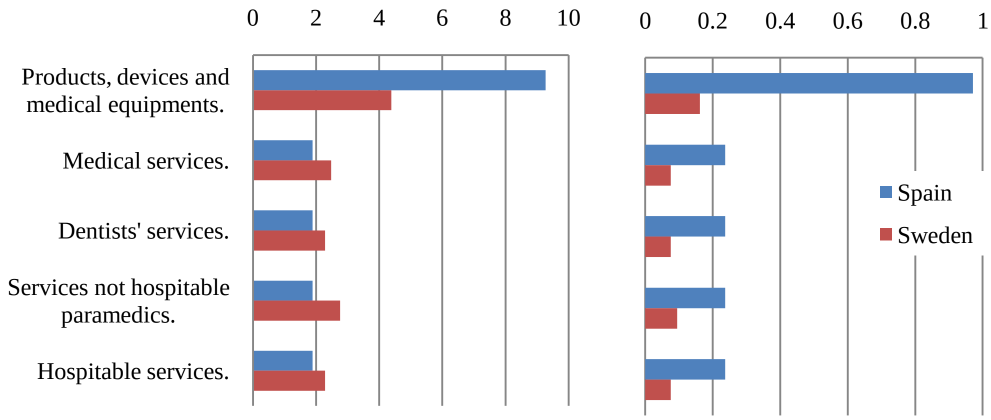

Figure A6: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for health products and services in Spain and Sweden.

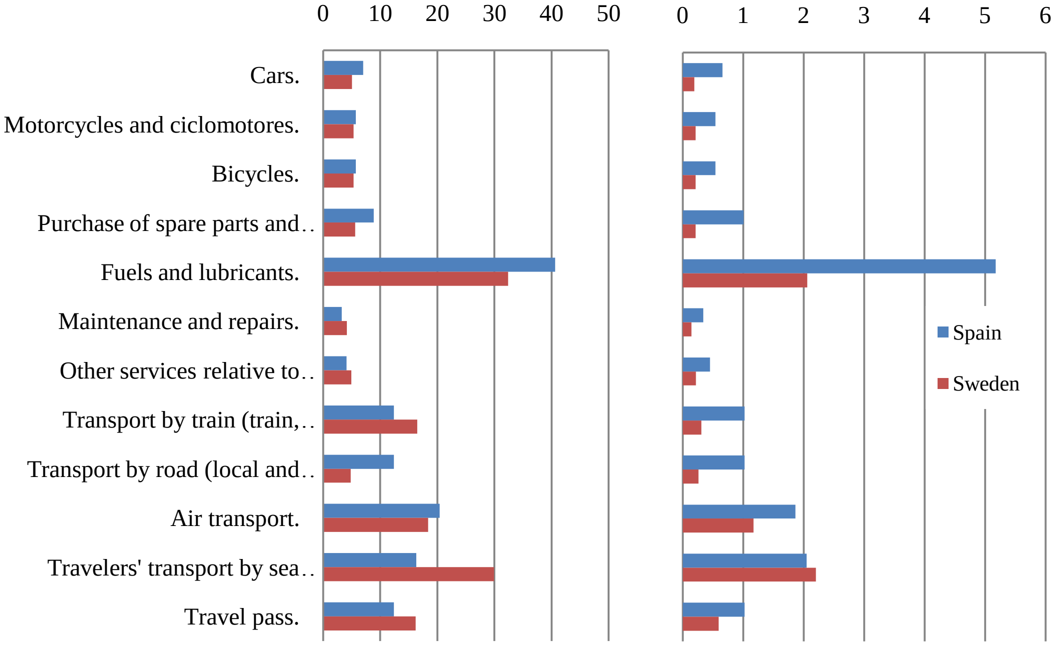

Figure A7: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for transport products and services in Spain and Sweden.

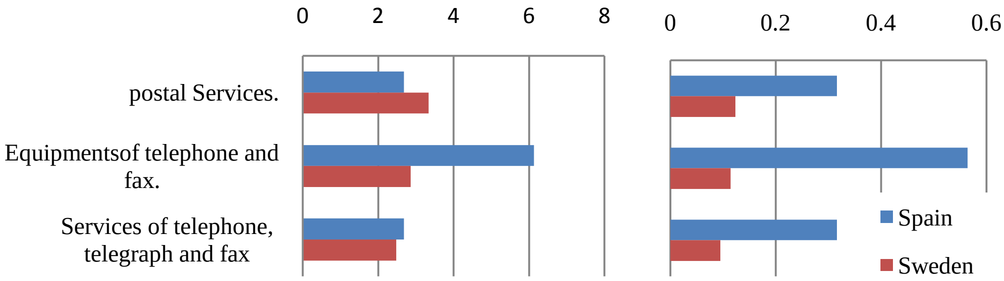

Figure A8: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for communication products and services in Spain and Sweden.

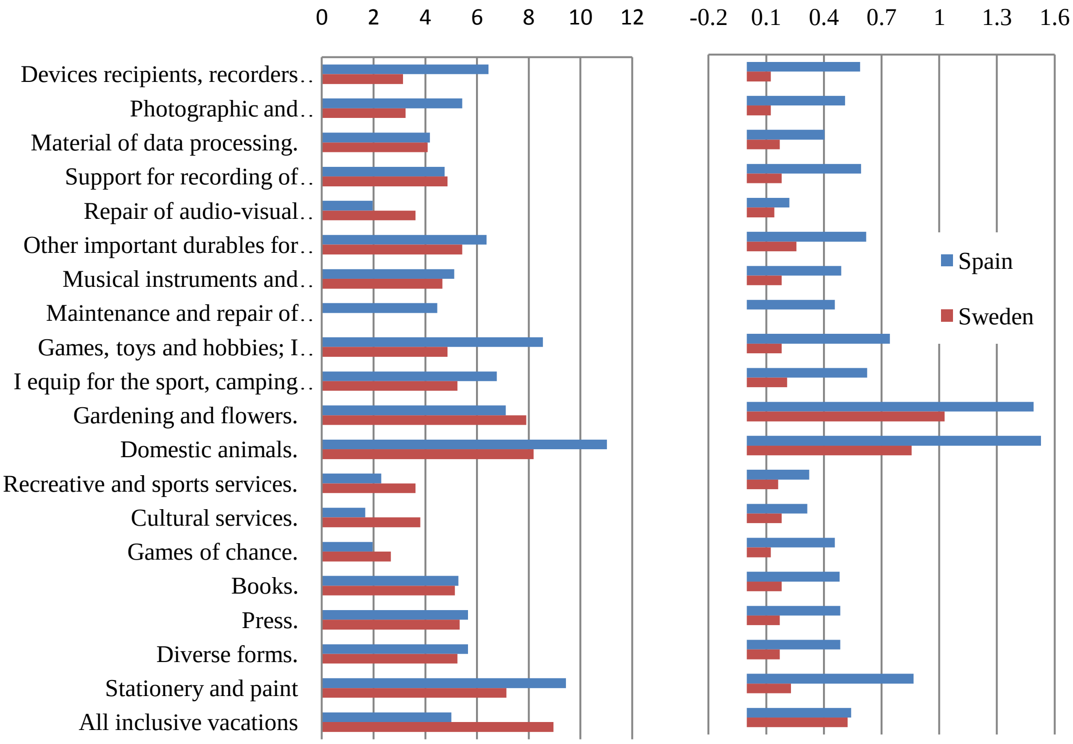

Figure A9: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for recreation and cultural products and services in Spain and Sweden.

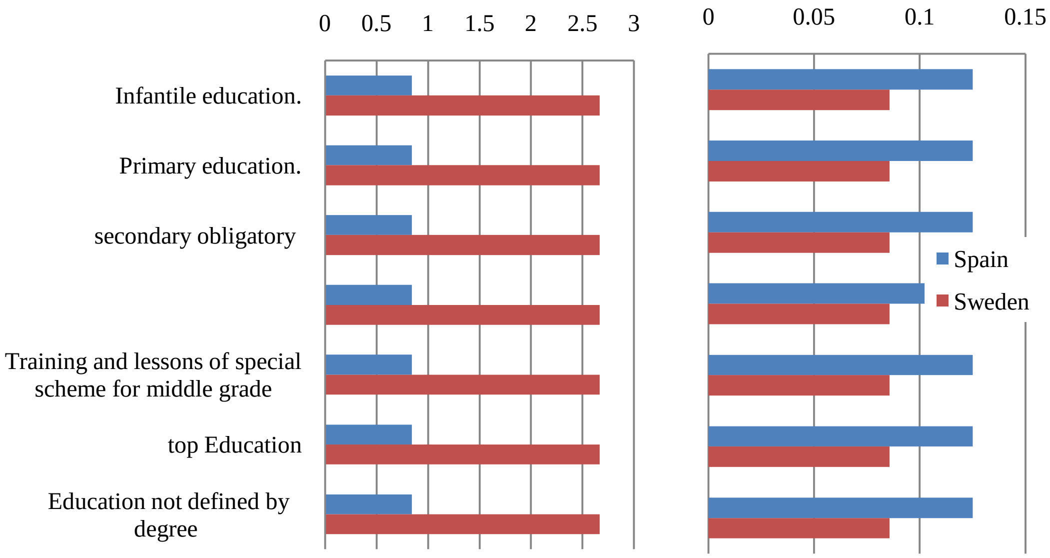

Figure A10: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for educational products and services in Spain and Sweden.

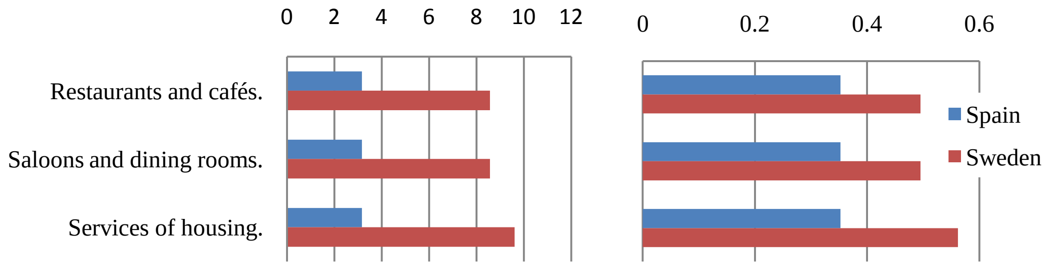

Figure A11: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for restaurant and hotel products and services in Spain and Sweden.

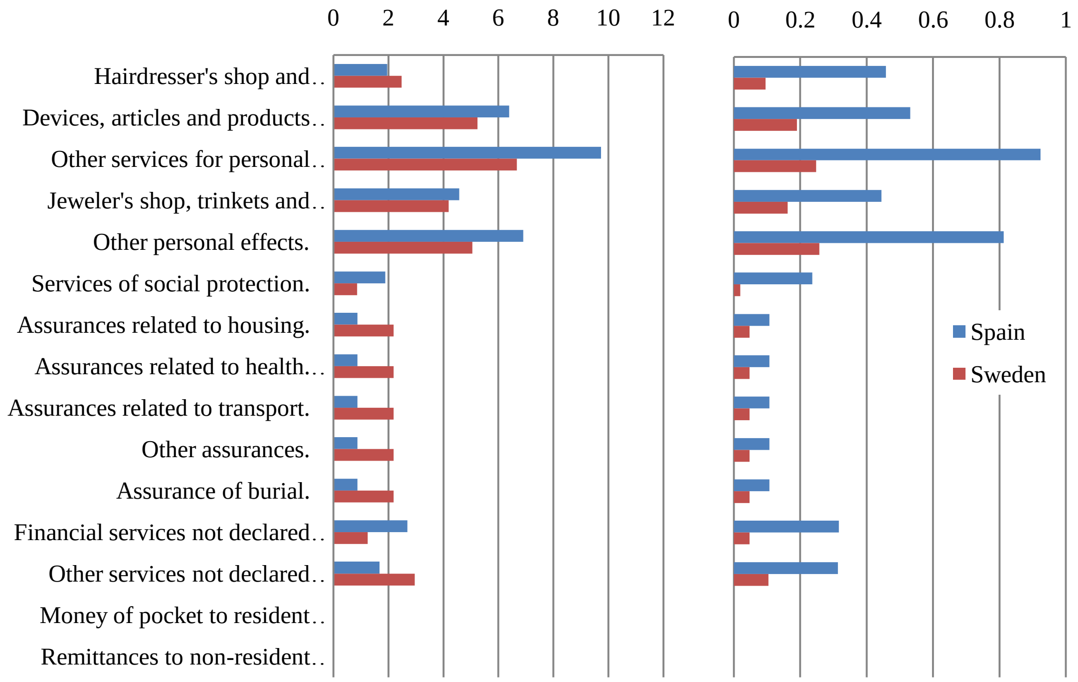

Figure A12: Comparison between energy intensities (MJ/Euro) and CO_2-eq intensities (Kg CO_2-eq/Euro) for miscellaneous goods and services in Spain and Sweden.