Milan Ščasný
Jan Urban
Iva Zvěřinová

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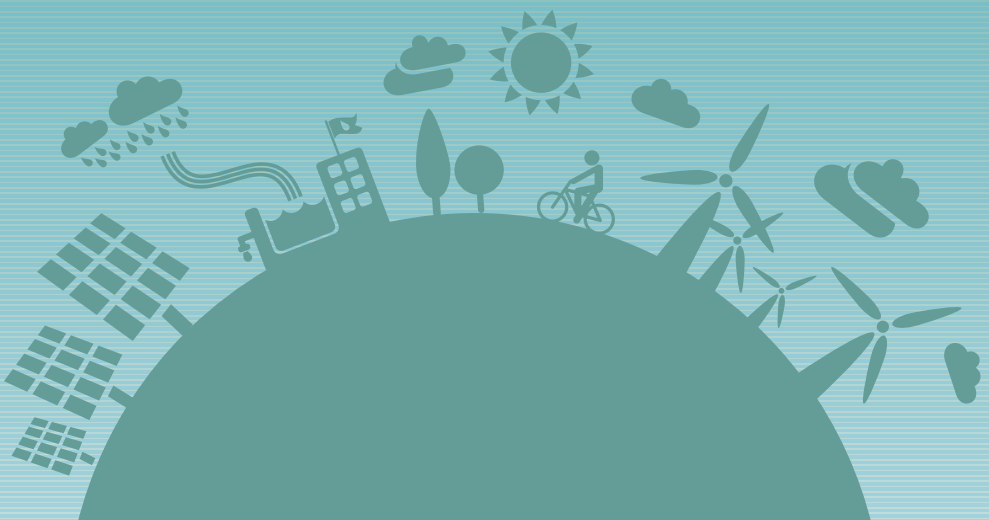
Environmentally Significant Behaviour in the Czech Republic: Energy, Food and Transportation



ENVIRONMENTALLY SIGNIFICANT BEHAVIOUR IN THE CZECH REPUBLIC: ENERGY, FOOD AND TRANSPORTATION

Milan Ščasný
Jan Urban
Iva Zvěřinová

Reviewed by:
Dr. Nick Johnstone (OECD, Environment Directorate)
Dr. Michal Mravec (CERGE-EI, Charles University in Prague and Academy of Sciences of the Czech Republic)

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Chapter 1:
Environmentally Significant Behaviour

Since the early 1970s, when the first studies on environmental behaviour (Arbuthnot & Lingg, 1975; Kinnear, Taylor, & Ahmed, 1974; Rickson, 1972) were published, many terms for behaviour related to the environment have emerged. In order to give some examples, we can mention several terms: green behaviour, pro-environmental or pro-ecological behaviour, environmentally significant behaviour, environmentally conscious behaviour, environmentally friendly behaviour, environmentally responsible behaviour, environmentally relevant behaviour, ecological behaviour, or environmental behaviour. The same terms were used in similar or different meanings and often were not properly defined, leading sometimes to confusion.

Based on common usage, it is possible to identify two types of terms. First, there are terms for behaviour with positive environmental effects (mostly reduction of environmental pressures), such as proenvironmental behaviour, environmentally friendly behaviour and environmentally responsible behaviour (Allen & Ferrand, 1999; Milfont, Duckitt, & Cameron, 2006; Oreg & Katz-Gerro, 2006). Second, several terms describe behaviour with important environmental effects both positive and negative, such as environmental behaviour and environmentally relevant behaviour (Grob, 1995; Harland, Staats, & Wilke, 1999; Poortinga, Steg, & Vlek, 2004).

An interesting contribution to conceptualization of behaviour related to the environment was made by Stern (2000) who suggested the term of "environmentally significant behaviour" that can be defined in two ways. First, it can be defined by its impact, "the extent to which it changes the availability of materials or energy from the environment or alters the structure and dynamics of ecosystems or the biosphere". Second, it can be also defined from the actor's

standpoint as a behaviour that is undertaken with the intention to change the environment. The author finds both definitions to be important for research, albeit for different purposes. The impact-oriented definition is essential for identifying behaviours that "can make a large difference to the environment" (Stern, 2000, p. 408) and is crucial in order to make research useful. The intent-oriented definition is needed for understanding and changing the behaviours.

In this book, we elaborate on the impact-oriented definition of environmentally significant behaviour (Stern, 2000). However, the application of this definition of environmentally significant raises some issues that need to be tackled. In the following part of this chapter, these issues are discussed and our approach to them is explained.

Scope of examined behaviours

The first issue is the differing range of scope of examined behaviours in empirical studies of environmentally significant behaviours. Gatersleben, Steg and Vlek (2002) pointed out that two basic streams of empirical studies can be distinguished. The first category of studies focuses on one specific behaviour, such as the purchasing of organic food. Other scientists develop scales that comprehend different behaviours (e.g., Allen & Ferrand, 1999; Diekmann & Preisendörfer, 2003; Grob, 1995; Kaiser, 1998; Kaiser, Wölfing, & Fuhrer, 1999; Karp, 1996; McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995; Milfont, Duckitt, & Cameron, 2006; Nordlund & Garvill, 2002; Pelletier, Tuson, Green-Demers, Noels, & Beaton, 1998; Schultz et al., 2005). These scales combine different behaviours, such as preferring paper bags to plastic ones, preferring showering to taking a bath. By means of statistical techniques, such as factor analysis and reliability analysis, researchers try to develop one or more scales of proenvironmental behaviour (Gatersleben, Steg, & Vlek, 2002).

In this book, we target several specific types of behaviour that fall into only one category of environmentally significant behaviour: to examine the category of consumer behaviour in relation to its environmental effects. Consumer behaviour can be defined as activities that people undertake when obtaining, consuming, and disposing of products and services (Blackwell, Miniard, & Engel, 2001, p. 6). Stern (2000) used the term private-sphere behaviours for a similar category of environmentally significant behaviour and empirically

distinguished it from other types of behaviours, namely environmental activism, non-activist behaviours in the public sphere, and other environmentally significant behaviours.

There are plenty of reasons for tackling the issue of consumer behaviour. First, although the growth of global population is a factor that increases pressures, "it is consumption and production patterns in developed countries, with developing countries catching up rapidly that are the key drivers of global environmental problems" (EEA, 2010, p. 6). In most countries, household consumption is responsible for more than 60% of the life cycle impacts of final consumption (United Nations Environment Program [UNEP], 2010). Second, changes in consumption behaviour are needed to complement technological developments as targeting consumption can tackle issues that production-focused and technology-focused policies cannot. Environmental benefits stemming from technical efficiency are partially or completely offset by consequential increases in consumption that are enabled by lower costs of production and/or use, which implies that more money can be spent on other/more goods and services, the so called rebound effect (Hertwich, 2008). Global environmental pressures that are experienced directly overseas but result from European consumption are not covered by current European production-related policies. These pressures can be directly reduced by affecting demand for specific types of imported goods (EEA, 2010).

Measurement of behaviours

The second issue is measurement of the performance of certain behaviour. In empirical studies, environmentally significant behaviour is measured via self-reported behaviour, other-reported behaviour, such as observation, or aggregate measures of the environmental outcomes of behaviours, such as meter readings (Chao & Lam, 2009; Gatersleben, Steg, & Vlek, 2002). However, most studies rely on self-reports in response to questionnaire items (Gatersleben, Steg, & Vlek, 2002), meaning that respondents are asked to report directly on their own behaviours (Lavrakas, 2008). Self-reported measures assume that people are able and willing to accurately answer direct questions about their behaviours (Stangor, 2011). The use of self-reported measures may lead to inaccurate reports of actual behaviour due to conscious or unconscious response biases, such as social desirability. However, many

studies show that the discrepancy between self-reported behaviour and actual behaviour is not systematic (for review see Gatersleben, Steg, & Vlek, 2002). Further, the studies that explored the effect of social desirability on reported environmental behaviour found that this effect is low or even non-existent (for review see Milfont, 2008). Finally, self-reported measures are relatively easy to construct and administer and allow the gathering of a lot of information in a short period of time (Stangor, 2011) and at lower costs. Therefore, we rely in this book on self-reported behaviours.

Moreover, there are other factors (not only response biases) that could result in discrepancies between reported behaviours and environmental impacts of these behaviours. Olsen (1981) specified several of such factors. One of the factors is related to the way the scales of proenvironmental behaviour are usually constructed. Respondents reporting many small conservation actions often receive a relatively high score on an action index, even though such actions may only have a marginal environmental impact. The weak point of some studies is that the choice of indicators of environmentally significant behaviour is based on the personal judgments of researchers. In order to measure behaviour more precisely, Grob (1995) for example, used a scale developed with the technical advice of experts in the Swiss and Cantonal Office of Environment.

Further, Olsen (1981) argued that researchers sum behaviours reported by respondents into an index, without taking into account the differences in their environmental impact; therefore this index may be a very imprecise indicator of environmentally significant behaviour. For these reasons, Poortinga, Steg and Vlek (2004) and Gatersleben, Steg and Vlek (2002) focused on household energy use measured by a scale developed on the basis of environmental science principles. These attempts are worth noting in order to examine the impact-oriented definition of environmentally significant behaviour. On the other hand, measuring households' home and transport energy use based on average annual energy use related to the possession or use of a few household goods is rather insufficient as an instrument for examining factors influencing behaviour defined by the impact on the environment.

In respect of the above mentioned measurement problems, instead of the construction of one scale of environmentally significant behaviour we develop one scale for each specific behaviour, such as the scale of cutting down on heating and air conditioning. In order to examine behaviours that significantly influence environmental quality (Steg & Vlek, 2009), we

use, as Steg and Vlek (2009) suggests, the results of environmental impact assessments that have been developed by environmental scientists. Based on these results, household consumption categories that contribute to pressures and environmental impacts to a larger extent are identified in following part of this chapter (see Figure 1.1 and Figure 1.2) and environmental effects of selected behaviours are discussed in detail in the corresponding chapters of this book.

Environmental impacts of individual behaviour or consumption categories

Third, the term "impact" has been also properly defined in the driver-pressure-state-impact-response framework (DPSIR), which has been adapted with some changes by many international organizations (Berge, Beck, Larssen, Moussiopoulos, & Pulles, 1997; EEA, 1999; UNEP, 1999, 2007). According to the DPSIR framework, Driving forces are social, demographic and economic developments brought to bear through changes in production and consumption which then put Pressure on the environment. As a consequence, the State of the environment changes, such as securing adequate conditions for health, resources availability and biodiversity. These changes have Impacts on human health, ecosystems and materials, which may evoke a societal Response that target the Driving forces, or the State or Impacts (EEA, 1999).

Although the use of the term "environmental impact" by Stern (2000) is in accordance with the DPSIR framework and refers to State and trends (see Figure 1.1), the link between individual behaviour, pressures and states is usually very complex, and often not even known. Probably for this reason, the few studies that seek to explain environmentally significant behaviour using the impact-oriented definition (Gatersleben et al., 2002; Poortinga, Steg, & Vlek, 2004) rely in fact on the drivers (defined in accordance with the DPSIR framework of UNEP 2007) that are associated with this behaviour (such as energy use). Although it seems to be quite difficult to find evidence on environmental impacts of individual behaviour, there are several studies available for industrialized countries on products and consumption categories that have the greatest impacts across their life cycle. Still, most of the studies focus on energy or greenhouse gas emissions and only a few studies include a wider range of environmental pressures (UNEP, 2010).

Direct and indirect consequences of behaviours

The fourth issue related to application of the impact-oriented definition of environmentally significant behaviour is decision whether to take into account only direct or also indirect consequences of one's behaviour. Direct pressures arise during the consumption of goods and services, such as emissions to air from motorised individual transport and energy sources used by households for heating etc. (EEA, 2011). Indirect pressures induced by consumption are all pressures generated along the whole production chains of goods (EEA, 2011). For example, direct energy use comprises the natural gas, electricity, heat, solid and motor fuels used directly by households. "Indirect energy use is the amount of energy that is used by the relevant production sector to produce and deliver goods (e.g., food) or services (e.g., public transport) to consumers" (Gatersleben et al., 2002, p. 340).

In order to illustrate the effect of consumption on the environment we applied the DPSIR framework to private (household) consumption. Figure 1.1 shows concrete environmental pressures and impacts of household consumption. Further, we report percentages of the total environmental pressures and impacts of the household consumption categories that contribute to environmental pressures and impacts to large extent (see Figure 1.1). However, the links between environmental impacts and human well-being are complex and sometimes difficult to measure (UNEP, 2010) and therefore we rely on general statements about impacts of environmental change on human well-being. Although there are available studies on health impacts due to environmental pressures, these studies do not address the health impacts of behaviour and life styles. In general, climate change, primary and secondary aerosols that result in respiratory problems seem to be the three most significant determinants of human health impacts (including potential human health impacts) (UNEP, 2010).

Further, we present empirical evidence on the household consumption categories that contribute to global pressures to the largest extent. As can be seen in Figure 1.2, household consumption categories with the highest share are housing, water, electricity, gas and other fuels, transport, and food. Figure 1.2 shows the proportion of these categories in total global pressures caused by household consumption in 9 EU countries (Austria, Czech Republic, Denmark, France, Germany, Italy, the Netherlands, Portugal, and Sweden). The pressures induced by household consumption comprise direct and indirect pressures. Both

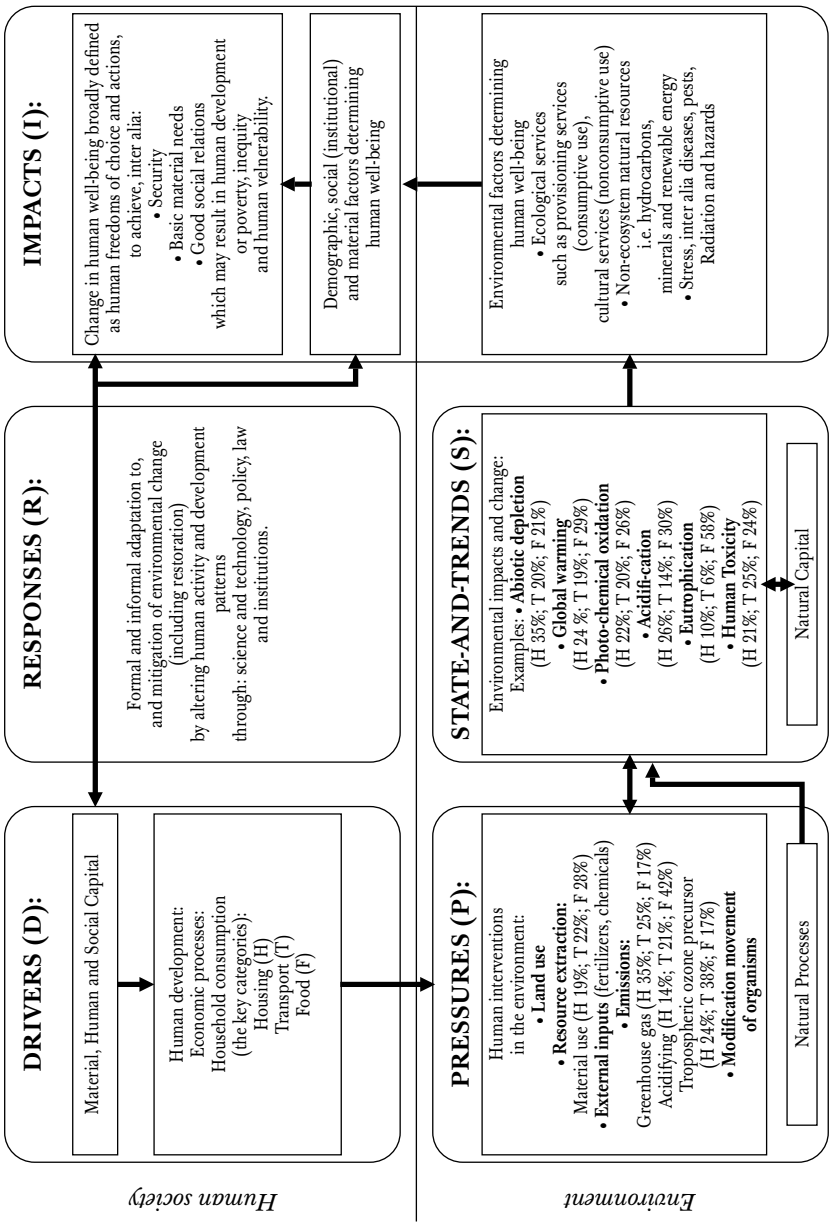
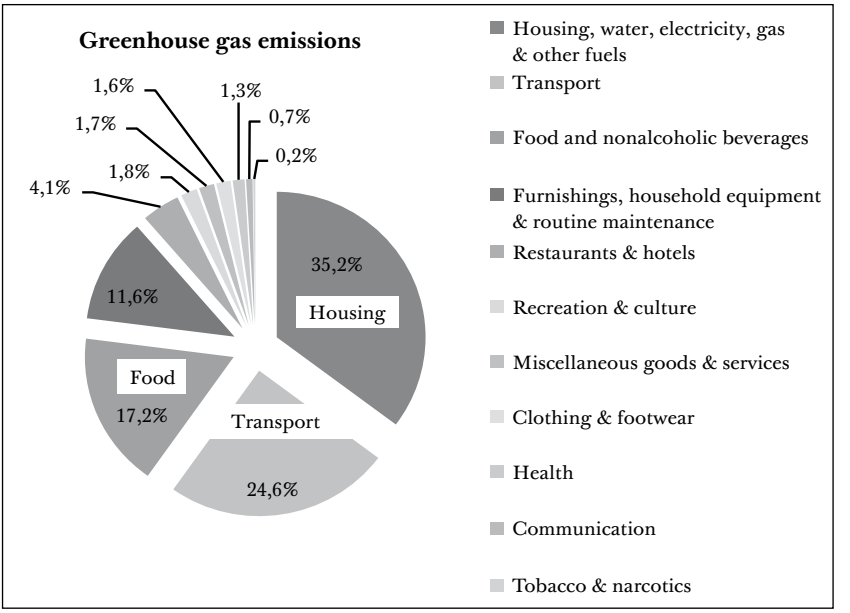
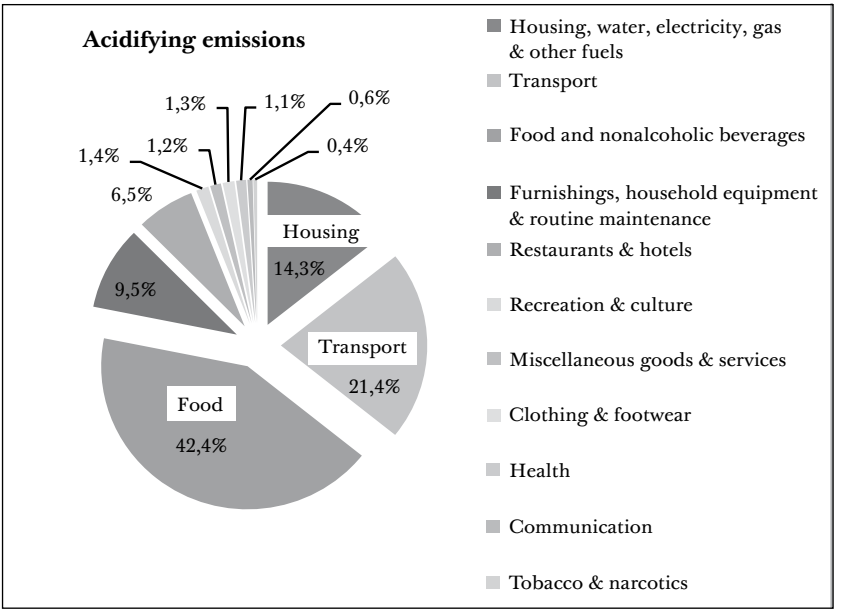


Figure 1.1 DPSIR framework applied to private (household) consumption
Source: Figure elaborated from UNEP (2007), data on environmental pressures (EEA, 2011) and environmental impacts (Huppes et al., 2006).


Greenhouse gas emissions
1,6%
1,3%
0,7%
1,7%
0,2%
1,8%
4,1%
35,2%
Housing
11,6%
Food
17,2%
Transport
24,6%
Housing, water, electricity, gas & other fuels
Transport
Food and nonalcoholic beverages
Furnishings, household equipment & routine maintenance
Restaurants & hotels
Recreation & culture
Miscellaneous goods & services
Clothing & footwear
Health
Communication
Tobacco & narcotics


Acidifying emissions
1,3%
1,1%
0,6%
1,4%
1,2%
0,4%
6,5%
Housing
14,3%
9,5%
Transport
21,4%
Food
42,4%
Housing, water, electricity, gas & other fuels
Transport
Food and nonalcoholic beverages
Furnishings, household equipment & routine maintenance
Restaurants & hotels
Recreation & culture
Miscellaneous goods & services
Clothing & footwear
Health
Communication
Tobacco & narcotics

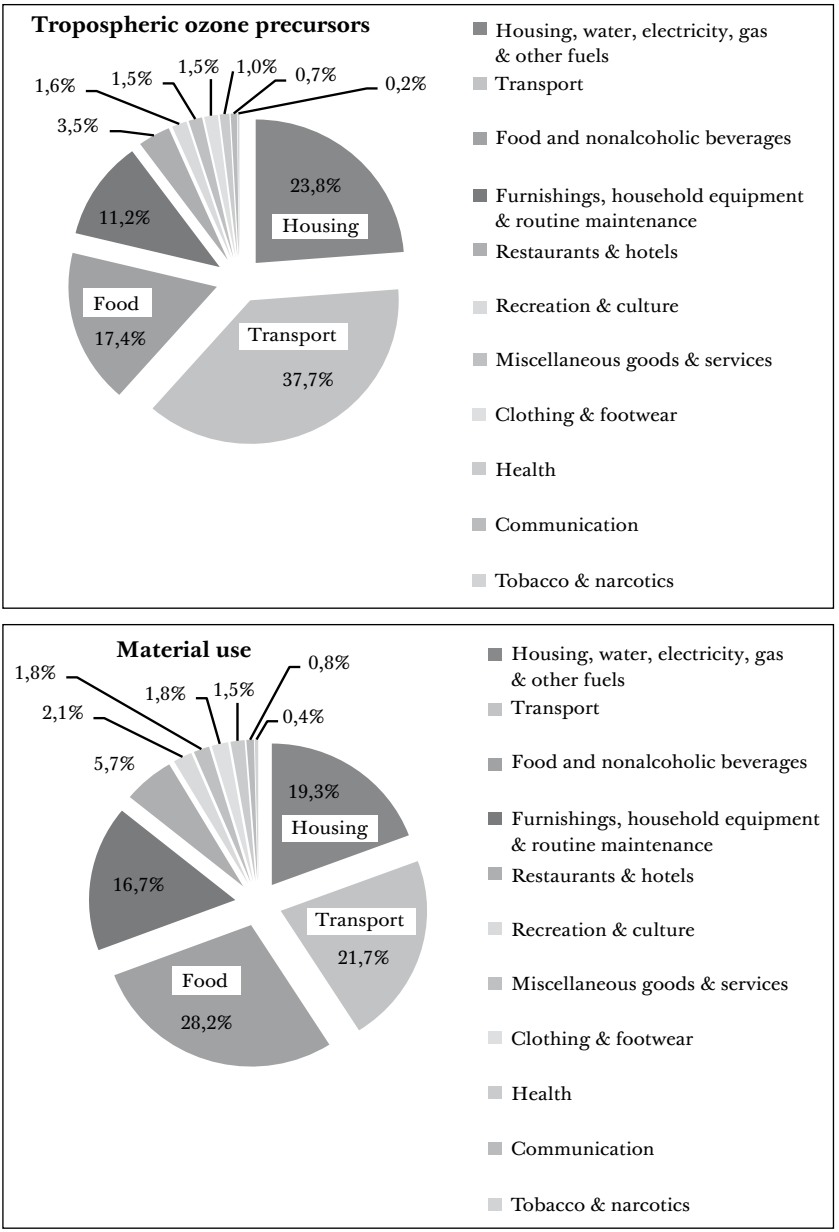
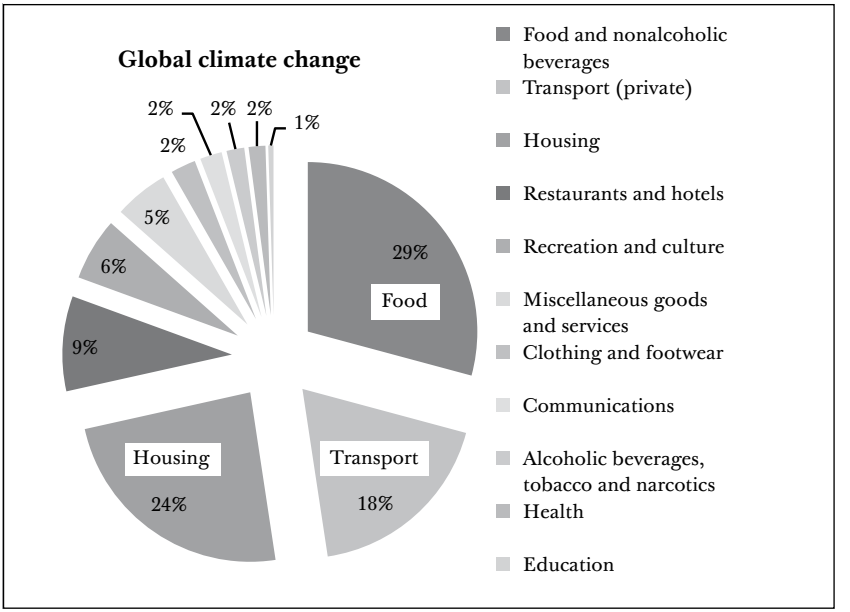
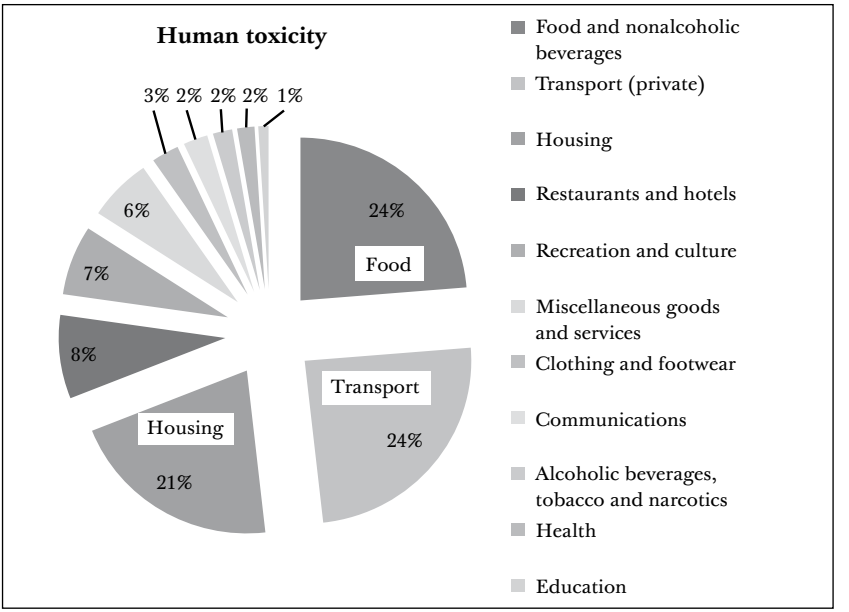


Figure 1.2 Direct and indirect global pressures caused by private (household) consumption distributed by consumption (COICOP) category in selected EU Member States, 2005
Source: EEA (2011) (modified by the authors)


Global climate change
2%
2%
2%
2%
1%
5%
6%
9%
29%
Food
Housing
24%
Transport
18%
Food and nonalcoholic beverages
Transport (private)
Housing
Restaurants and hotels
Recreation and culture
Miscellaneous goods and services
Clothing and footwear
Communications
Alcoholic beverages, tobacco and narcotics
Health
Education


Human toxicity
3%
2%
2%
2%
1%
6%
7%
8%
24%
Food
Transport
24%
Housing
21%
Food and nonalcoholic beverages
Transport (private)
Housing
Restaurants and hotels
Recreation and culture
Miscellaneous goods and services
Clothing and footwear
Communications
Alcoholic beverages, tobacco and narcotics
Health
Education

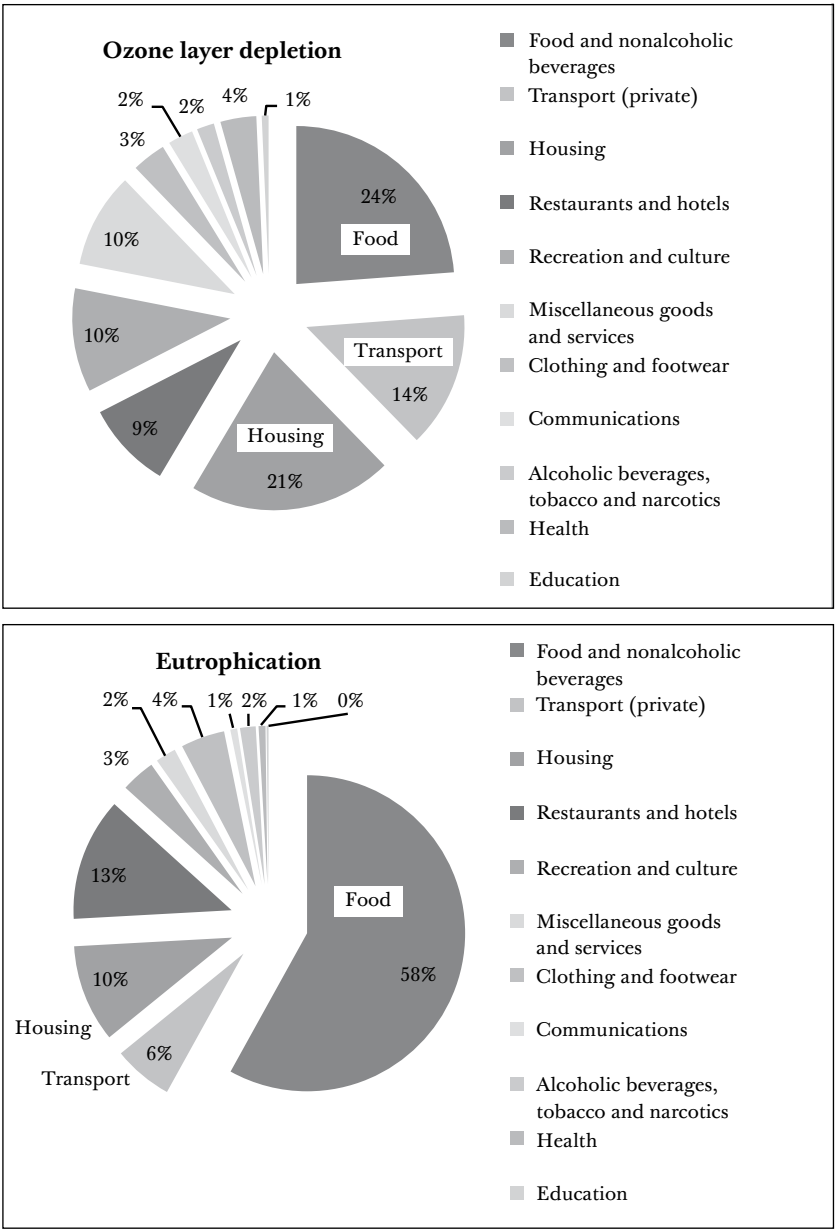


Figure 1.3 Environmental impacts of household consumption distributed by consumption domains in the EU25 (Environmental scores (%) for 12 aggregate consumption domains) Source: Figure created by the authors from data in Huppes et al. (2006).

the pressures of goods produced domestically and imported goods were included and four environmental pressures were analysed – greenhouse gas emissions; acidification emissions; tropospheric ozone precursors and material consumption (EEA, 2011).

Food and non-alcoholic beverages, private transport and housing (including water, electricity, gas, other fuels, furnishings, household equipment, and routine house maintenance) are also the largest contributing consumption domains to most of the environmental impacts by consumption in the 25 European countries (Huppes et al., 2006). The impact categories that are covered by this study are abiotic depletion, global climate change, ozone layer depletion, human toxicity, ecotoxicity, photochemical oxidation, acidification, and eutrophication. This study presents the resulting scores on the impact categories "as a percentage of the European (EU25) total score in the impact category, that is, in normalized form" (Huppes et al., 2006, p. 133). In order to graphically present the resulting scores on the selected impact categories, we created Figure 1.3 from the data reported in this study. Overall, results are quite similar for all environmental impact categories. However, there are exceptions concerning transport and food domain. While transport has a high score on human toxicity, food is responsible for a large share of eutrophication (Huppes et al., 2006) (see Figure 1.3).

In conclusion, studies targeting industrialized countries indicate that housing, mobility, food and electrical appliances typically represent over 70% of the household consumption impacts (UNEP, 2010). Also according to Tukker and Jansen (2006), housing, transport, and food are the three main policy priorities which are the cause of for 70% of the environmental impacts in most categories, although only 55% of the final expenditure are spent on them in the 25 EU countries. Thus, this book is focused on transport (propellat consumption and passenger car ownership) and behaviours related to energy consumption (one-time efficiency retrofits, curtailments), and food consumption (organic food buying behaviour).

Chapter 2:
Factors of Consumption Behaviour and Their Policy Relevance

The preceding Chapter 1 has pointed to the environmental significance of consumption behaviour. The main aim of this chapter is to explain to the reader the limitations of our approach in terms of practical lessons to be learned from this book, but also why we think that this book can still serve a practical purpose in spite of these limitations.

As has been outlined in the previous chapter, this book focuses on three broad types of domestic consumption behaviour that together are responsible for the bulk of households' environmental impacts: consumption of energies in households, consumption of food, and transportation. As a matter of fact, the three classes of consumption behaviour are very different and could be further subdivided into distinct behavioural categories. Consequently, models that are used in the empirical literature to capture in simplified form the relationships between diverse factors and consumption activities (for their overview see, e.g., Jackson et al., 2005) are usually not used across the full range of consumption activities but rather in one specific area where their application seems to be most appropriate.

The focus of the present book is not so much to explain as to describe consumption behaviour. This book specifically aims to describe the socio-economic and demographic factors that segment the population with respect to consumption behaviours addressed in this book. As explained in the section below, socio-economic and demographic factors are relatively more distant precursors of consumption behaviour. We try to justify the focus of the present book on how the consumer population is segmented along socio-economic and demographic lines in the concluding section of this chapter.

What are the determinants of consumption behaviour?

As already noted, consumption behaviour is influenced by many factors that may even be specific to certain types of consumption. Monetary factors such as available income or the cost of a particular comodity certainly play a role but the empirical literature shows that other factors may be even more important. On the other hand, socio-demographic factors are frequently found to affect behaviour indirectly and their influence on consumption behaviour is usually mediated by more proximal variables. Let us now look more in detail at the specific consumption behaviours addressed in this book and their determinants as found in the empirical literature.

Energy consumption and energy conservation

Energy consumption and energy conservation are two broad topics adressed in Chapter 3 (demand for energy), Chapter 4 (efficiency investments) and Chapter 5 (energy saving curtailments) of this book. Models that are used to explain energy consumption and energy conservation are usually very complex (cf. Black et al., 1985). The main difference between energy consumption and energy conservation with regard to their determinants is that energy consumption is usually very closely related to the socio-demographic structure of the household, while energy conservation is affected by socio-psychological factors (Abrahambse and Steg, 2009). The reason for this difference probably lies in the fact that demand for energy is derived demand which reflects the preferences of individuals only indirectly (through their preferences for services generated by energy-consuming appliances), while conservation actions are usually motivated.

Besides sociodemographics (see Halvorsen and Larsen, 2001), energy consumption is also sensitive to energy prices and disposable income (see our thorough discussion of price and income elasticities in Chapter 3 of this book) as well as some macro-factors such as cultural standards (e.g., convenient indoor temperature – see Kriström, 2006), availability of energy and particularly heating-energy resources (see Brůha and Ščasný, 2006), and, quite obviously, climatic conditions (Mensur, Mendelsohn and Morrison, 2008).

Clearly energy conservation is linked to perceived energy consumption (Black et al., 1985): people make efforts to save energy that they would otherwise consume. However, as already mentioned, energy conservation is distinct from energy consumption in that internal motivation plays more important role here. Nonetheless, internal motivation is not the only

factor of energy conservation. Energy-saving activities are only enacted when consumers are aware of the need to save energy, and also aware of ways to save energy, when they are motivated to do so and when they are able to adopt a particular energy-saving activity (Steg, 2008). If any of these conditions is missing, energy conservation is not fully enacted.

Organic food consumption

Organic food consumption, another important consumption activity in the domestic sector, is covered in Chapter 7 of this book. The range of factors that cause consumers to prefer organic food to conventional food is very broad and includes such factors as consumers' values, attitudes and emotions, their personal norms as well as actual and perceived social norms, perceived and actual barriers to the purchase of organic food, socio-demographic factors, and macro-factors (Aertens et al., 2009). Importantly, as Thøgersen (2010) points out, macro-factors that include political framework (regulations, subsidies, control, certification, labeling and provision of information), and the market framework with respect to supply on the one hand (soil and climatic conditions, relative prices, and the development of distribution channels) and demand on the other (food culture and general income level) can play an important role as factors of organic food consumption, especially in multi-country comparisons.

Car ownerhip and demand for car transportation

Car ownership (addressed in Chapter 6) and demand for car transportation (addressed in Chapter 3) are two closely related issues: car ownership is a pre-condition of car transportation and car transportation is probably the most important motivation for car ownership. Demand for personal car transportation is influenced by the socio-demographic structure of households, which includes disposable income, availability of public transportation system, spacial characteristics and infra-structural characteristics of the region, and socio-cultural factors (e.g., social desirability of car transportation) (see Dargay, 2002). Car ownership seems to be influenced by a very similar set of factors as the demand for personal car transportation, namely financial resources available to the household, size and socio-demographic composition of household, and characteristics of the wider environment the household inhabits (Whelan, 2007).

* * *

As can be seen from this short exposition, the importance of various determinants varies across different consumption behaviours making any generalizations difficult. A useful conceptual framework that integrates various factors of consumption behaviour has been proposed by Stern and Oskamp (1987) and is presented in Table 2.1 below. This conceptual scheme, originally proposed for domestic energy conservation, can be extended to any type of consumption behaviour. This framework suggests that it is possible to order causal factors of consumption; those causal factors at a higher level of causality are more indirect precursors of behaviour, influencing behaviour mainly through lower-level causality factors. Nonetheless, higher-level factors can be, under certain circumstance, also influenced by lower-level causality factors: for instance when people learn from the outcomes of their behaviour or when they adjust their attitudes after learning new information.

Table 2.1 Model of causal ordering of factors of consumption behaviour with examples from domestic energy conservation

Level of causality	Type of variable	Examples
7	Household background characteristics	Income, education, number of household members
6	External incentives and constraints	Energy prices, size of dwelling, owner/ renter status, available technology, difficulty and cost of energy-saving action
5	Values and worldviews	New environmental paradigm, biospheric-altruistic values, postmaterialism
4	Attitudes and beliefs	Concern about national energy situation, a belief household can help with it, a perceived peer pressure from neighbours
3	Knowledge	Knowing that a water heater is major energy user, knowing how to upgrade attic insulation
2	Attention, behavioural commitment etc.	Remember to install weather stripping before heating season
1	Resource-using or resource-saving behaviour	Decrease use of air conditioner, purchase of high-efficiency furnace, lowering winter thermostat setting

Source: Adapted from Stern and Oskamp, (1987).

This conceptual scheme shows that socio-economic and demographic variables are located at a higher level of causality and their effect on

behaviour is mediated by such factors as values, attitudes, knowledge, intention and behavioural commitment. On the other hand, some socio-economic and demographic variables are likely to differentiate between consumers precisely because these variables influence most of the factors at a lower level of causality.

Predictive and causal interpretation

Throughout this book, we refer to evidence from empirical models of consumer behaviour. Such models that represent a general and simplified picture of reality can be interpreted in two fundamentally different ways: predictively and causally.

The predictive interpretation of statistical models rests on the formulation of statistical inference (estimate, test, posterior distribution) about associational parameters that relate a response variable and attribute variable taken from the universe of such units. It is important to notice that response and attribute variables are logically on the same footing and one cannot say that one causes other unless he or she is willing to make further assumptions (Holland, 1986). A typical question framed in the predictive framework is "how does the outcome variable differ, on average, when comparing two groups of units that differ by 1 in the relevant predictor while being identical in all other predictors?" (Gelman & Hill, 2007, p. 34). Importantly, predictive models cannot answer the question of what would happen should the particular unit be changed. In that respect, predictive models provide only a description of the existing population but they can never tell us what would happen should the units of the sample or units of the population be different. The latter would require causal statements.

The goal of causal modelling is to predict what would have happened to a particular unit were the conditions of action or treatment different. Causal modelling raises the so called "fundamental problem of causal inference", the fact that we cannot observe alternative states of the same unit at the same time. One of the ways to solve this problem is to use statistical methods, including statistical modelling, combined with additional assumptions (e.g., assumption of conditional ignitability[1]) to arrive at causal statements (Holland, 1986).

1 In order to make a causal inference based on non-experimental studies, one has to adopt additional assumptions above and beyond those used in randomized experiments. One of the most important assumptions used in observational studies to arrive at causal statements is the assumption of ignorability. This assumption postulates that the assignment of treatments

The important thing to note is that causal statements can never be proved by the data, not because the data come from non-experimental studies but for principal reasons. Even the best randomised study does not provide proof of causal statement because the additional assumptions needed in combination with statistical evidence to make causal statements are not themselves deducible from data (see, e.g. Pearl, 2009). Another complication for causal modelling lies in the fact that only those factors that could be, in theory, manipulated meet the condition of exposability and can be labelled as causes (Rubin, 1974).

It is interesting to notice that statisticians were, until recently, very hesitant in dealing with the issue of causality and causal interpretation of statistical models (cf. Holland, 1986), while professionals working in other fields who were actually applying statistical models have usually not hesitated to assume that their analysis is truly capable of revealing causal relationships (for some examples and critique of such inappropriate approach in studying the causality in the field of econometrics see, e.g., Leamer, 1983). The reason why statisticians are hesitant to accept causal assertions while scientists in other fields have the propensity to make causal inference more frequently lies perhaps in the fact that the former are more aware of the principal non-testability of the assumptions necessary in order to make a causal inference, while the latter are aware of the fact that much of the actual scientific work consists of making and testing causal inferences and also are more aware that throughout its history science has generated many causal statements that seem to be plausible in the light of our knowledge and experience.

The difficulty of deriving causal statements and the confusion that is associated with this task can be illustrated by two approaches to causal inference that have been heavily criticised recently for not respecting some of the necessary conditions for causal inference, such as the assumption of conditional ignorability or the principle of exposability[2].

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to units is an ignorable condition on pre-treatment (or confounding) variables (Rosenbaum & Rubin, 1983). The implication of this assumption in regression analysis is that if we control for confounding variables that have an effect on the dependent variable, the values of the main causal explanatory variable are distributed randomly across the units.

2 This condition requires that each unit must be potentially exposable to the cause (Rubin, 1974). This criterion has several implications for the definition of a cause, which may be more important in the context of observational studies because often they are not self-evident. One of these implications of the exposability requirement is that pre-treatment variables should be carefully differentiated from post-treatments variables. However, observational data alone cannot be used to select the pre-treatment variables so additional assumptions, usually derived from theory, must be postulated. Another implication of the exposability principle is that

The first example of causal inferences that were criticized that is worth mentioning is the so called causal modelling frequently used in social sciences (see e.g. Blalock, 1985). These causal models are usually represented in the form of path diagrams with these causal paths being based on measures of association. One of the problems of these models lies in the fact that meaningful and meaningless causal statements (i.e., those that include, for instance, post-treatment variables or attributes as causal factors) are not always carefully separated in empirical applications of causal modelling (Holland, 1986, p. 958). However, causal modelling seems to be potentially a very interesting field for the development of causal inference and attempts were undertaken to combine causal modelling with appropriate causal inference approaches (see e.g. Pearl, 2009).

Another example of a criticized causal model is that proposed by Granger (Granger, 1969) and used frequently in econometrics. In Granger's model the temporal dimension is very important as it allows differentiation between the cause and the effect (the cause chronologically precedes the effect) and for that reason panel data is particularly suitable for this model type. The cause is then defined as a variable that improves our ability to predict another variable. This model of causal inference is still quite popular in today's econometrics and often leads to attempts to build ad hoc models that include as many variables as possible and where the only criteria whether to include a variable rests on its ability to increase the predictive power of the model. However, these approaches are nowadays criticized by many statisticians who argue that causal models based on observational data should resemble experimental models and should be carefully framed in the theory. Otherwise the

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inherent attributes of units cannot constitute causes because units cannot be exposed to them. To put it differently, "it is epistemological nonsense to talk about one trait of an individual causing or determining another trait of individual" (Kempthorne, 1978, p. 15). Causes are only those variables that could be, in principle, treatments in experiments (Holland, 1986, p. 954). In this respect, it is not correct to talk about the causal effect of, for instance, gender, without making an additional assumption. The reason is that the person has its gender as his or her inherent trait that defines him or her. We cannot seriously think about potential exposability of individuals to their different gender. For that reason gender is used in descriptive modelling rather than causal inference. As a matter of fact, certain social science disciplines, such as social psychology, frequently make use of unobserved psychological constructs in their causal models (for instance theory of planned behaviour, norm-activation theory, or value-belief norm theory to name but a few). To be able to deal with these constructs as causal factors, these disciplines must make the assumption that these factors can be separated from what constitutes the individual. This assumption can be justified only in a specific theoretical framework and is never proved.