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METHODS

Environmentally sustainable household consumption: from aggregate environmental pressures to priority fields of action

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Abstract

Unsustainable consumption patterns of the North (or rather of the global affluent consumers class) have been identified by Agenda 21 as one of the key driving forces behind the unsustainable development. However, neither accounting based on the system of national accounts SNA nor household economics provide the proper instruments to assess the environmental impact of household decision making. Eco-efficiency assessments as familiar in the business sector provide no appropriate tool for households. As an alternative an environmental space based assessment scheme is suggested covering the major pressures on the environment caused by household decisions. The methodology is used twice: once to analyse the environmental relevance of the main activity clusters of household consumption and once to identify the dominant acts of consumption within each cluster. The latter provide the basis for deriving environmental performance indicators. A rough analysis of household influence potentials permits to identify housing, eating and mobility as the three priority fields for action for minimising the environmental impact of households. Extending the influence analysis actor matrixes are derived allocating influence and thus responsibility for environmental pressures to different groups of economic agents.

Keywords: Sustainable consumption; Consumption clusters; Environmental space; Indicators; Land use; Material flows

1. Introduction

The need to reduce the environmental burden from consumption has come a long way from an exotic point of view when Vance Packard published 'The Waste Makers' (Packard, 1960), to an element of mainstream thinking. In 1992 the UNCED conference identified '*the unsustainable pattern of consumption and production, particularly in industrialised countries*' to be a '*major cause of the continued degradation of the global environment*' (United Nations, 1993, chapter 4), and UNCSD undertook to develop guidelines and indicators for more sustainable such patterns (UNDESA, 1998). Nonetheless, the debate on the role of affluent consumers in the transition towards sustainability is as heated as ever. Some researchers (e.g. Schor, 1992) focus on the negative social, environmental and economic aspects of consumerism and con-

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sider compensatory consumption as an inferior substitute for a self-determined life (Scherhorn, 1991). Others have shown that high levels of consumption are not necessarily irrational or misguided but a rational behavioural pattern (Cogoy, 1999; Roepke, 1999).

Whatever the motivation, there is a consensus that particular responsibility for the level, composition and impact of consumption rests with the affluent inhabitants of Europe, North America and Japan. They, and the thriving rich elite in the transition countries and in the South (few as compared to their population, but significant in absolute figures) constitute a global consumer class, with shared products, lifestyles and aspirations (Robins and de Leeuw, 2001), and significant environmental impacts. To identify their options for effective damage-reducing action, a methodology for assessing the environmental impact of consumption from an *actors-centred perspective* is needed. So far, there is neither any consensus on what the necessary preconditions for changing consumption patterns are (Schultz et al., 1999), nor on how to measure the environmental impact of households (we refer to households as social entities with internal and external interactions as opposed to the idea of the atomic consumer). Thus it is rather undefined how influential households are in determining the burden on the environment (Jacobs and Ropke, 1999), resulting in widely varying estimates.

A significant number of methodologies for the life-cycle wide assessment of different kinds of environmental impacts has been developed and applied, mostly on the product level. Nonetheless, there is no clear-cut way of deriving a macro-level assessment of the overall environmental impact and allocating the responsibility for it to any individual or institutional actor, with responsibility here defined to be proportional to the relative influence on the consumption decision in question. This is not a problem of data deficiencies, but a methodological one.

The first systematic problem results from the need for a standardised measure of the overall environmental impacts. So far the measures suggested have mainly been based on single substances or substance groups (fossil fuels, heavy metals, air quality indices, etc.), on aggregating different impacts to one or few environmental pressure indices (EuroStat, 1999) or on the consumption of one specific resource. Examples for the latter are exergy (usable low-entropy energy, Ayres et al., 1996), material input per unit of service (mips, Schmidt-Bleek, 1992a), and the ecological footprint (Rees and Wackernagel, 1994). However, while due to their simplification effect all these measures are helpful for communication purposes, the same effects renders them less suitable for guiding decisions in households, business and politics.

The definition of responsibility as proportional to relative decision making power causes a second systemic difficulty. Different (groups of) economic agents occupy overlapping spheres of social, economic and political influence in highly differentiated and time-variant patterns. Power balances can change from product to product, from region to region and from time to time, making a quantitative assessment of the relative influence virtually impossible. Such a quantification of influences, however, would be a precondition for an allocation of environmental responsibilities to specific actors like consumers. As a result of these difficulties no scientifically rigorous macro-level allocation of responsibilities for the impacts of consumption to specific groups of actors, such as households, has been developed so far.

The two currently used accounting frameworks, based on the macroeconomic system of national accounting and on home economics, respectively, are not suitable for this purpose. The SNA monitors financial flows (and in extended versions resource flows and time consumption, Stahmer, 2000), regardless of who determined the size and direction of flows. Home economics accounts for production and consumption processes within the household itself, thus neglecting the upstream decisions they influence indirectly. Any attempt to overcome this weakness, however, is faced with the already mentioned impossibility to quantify the roles of different economic agents in the overlapping spheres of influence. Both accounting frames can be applied using different numeraires like money (e.g. Fukami, 1999), physical resources (e.g. Ayres et al., 1996) or time (e.g. Cogoy, 1995). Both methods are not able to adequately address

the relevance of household consumption for the total environmental impact, nor could any other fixed accounting framework be. Instead, in this paper a stepwise approach is suggested:

1) identify the activity clusters comprising resource consumption ('consumption clusters') of dominating environmental significance;
2) amongst them, identify those that are under the control of households;
3) find the key decisions that dominate the consumption cluster and identify the actors responsible.

Only then can indicators be derived and suggestions for reducing the environmental impact of household consumption be made. By focusing on the dominant clusters and the key decisions within them, this procedure avoids excessive collection and processing of data on non-essential components of household consumption or on impacts of minor environmental relevance. Therefore, it is cost-effective in identifying priority fields of action.

Section two of this paper introduces the new methodology for an actors-centred analysis, combining elements of SNA-based and home economics accounting and modifying them. A simple but directionally secure measure of the overall environmental impact is a necessary tool to analyse how households could modify their consumption for the benefit of the environment. In Section 3 the *environmental space* concept is suggested as such a tool (Opschoor and Costanza, 1993; Spangenberg, 1995).

The total consumption of environmental space (energy, material, land) is subdivided into ten consumption clusters, such as housing, nutrition and social life, together covering more than 95% of the total resource consumption (Lorek and Spangenberg, 2001a). For these clusters, environmental space consumption is presented in Section 4, based on SNA-like physical input–output-tables. So the environmentally relevant consumption clusters are identified, however, without providing information on the respective responsibilities of the actors involved. The analysis of actors for individual consumption patterns is described in Section 5, resulting in a semi-quantitative actors matrix. The spheres of influence identified are specific to the institutional settings in the area under investigation, for the purpose of this study to Germany (and similar in most of Western Europe).

In Section 6, the analytical process is illustrated in a case study on housing. Section 7 concludes, pointing to the possible use of the methodology developed and the indicators derived for monitoring change. It turns out that a quantitative measurement of the environmental impact of households is not possible, but spheres of influence of households and other relevant actors can be identified.

2. Measuring environmentally sustainable household consumption

Despite the broad consensus regarding the need to develop and support more sustainable consumption patterns (OECD, 1998; UNDESA, 1998), the areas in which households can make a significant contribution to sustainable consumption are still largely unexplored (e.g., Cogoy, 1995; Haake and Kamminga, 2001). So far, no coherent actors-centred concept has been developed.

2.1. Eco-efficiency: no measure for households

Much of the *sustainable consumption debate* has focused on assessing the eco-efficiency of goods and services in a life-cycle perspective (WBCSD, 1999). The impacts from production, use and disposal of products are taken into account as environmental costs, and the volume of services delivered as benefits, measured e.g., as *mips*, material input per service unit (Schmidt-Bleek, 1994). With a reduction of resource use per service unit e.g., by a factor 10 or 4, even an increasing consumption of services need not be unsustainable (von Weizsäcker et al., 1997).

Unfortunately, the definition of services in these formulas is ambiguous, partly based on more traditional concepts of unsustainable desires for a maximum of utility (Giarini, 1992) and partly extended to include factors exogenous to the neoclassical model like the satisfaction from ethical

motives (Stagl and O'Hara, 2001). In either case, a certain act of consumption and the use of time, work and resources needed to make it happen are allocated to one specific purpose (not least to avoid double counting when trying to quantify household impacts). The environmental impact of the consumption act is then allocated to this motive when calculating the environmental burden stemming from fulfilling specific needs or wants. For example 100 km of transport is considered a service, and the impact of providing it by car or by rail can be compared (Schmidt-Bleek, 1994).

However, household decisions are hardly ever monocausal, but incorporate and react to a variety of influences and interests, all mutually influencing and modifying each other. Consequently, the utility from household consumption is not homogenous and cannot be derived by aggregating single purchases. There is no direct micro–macro link, making it problematic to assess the total service derived from one household's consumption, let alone from all households' or consumers'. Therefore the methodology introduced here focuses on absolute measurements, not on the relative impact per service and irrespective of the cost invoked or the time invested, as both can but need not be directly correlated with the environmental impact.

2.2. Households as actors—no frame for accounting

Not only is the allocation of certain decisions to a single motive highly arbitrary, the allocation of responsibility for any such decision to the specific actors involved is problematic as well. However, successfully doing so for the household sector is an essential precondition for assessing its environmental impact.

To date, two ways of accounting are used in the environmental impact assessment of households:

- Macroeconomic accounting is based on the system of national accounts. Its input–output-tables with households as final users allocate the upstream expenditures for the production of consumption goods to this sector. It refers to flows, not to the agents activating them.
- Home economics assesses the production and consumption activities within the households, i.e., without taking upstream impact generation into account. In its extended version, it allocates the effects of each activity to the immediate actors, with no reference to reasons for and benefits from the respective activity.

In Germany, for example, the former approach is used by the Statistical Office, while the Environment Agency usually refers to the latter one, with significantly differing results. Table 1 demonstrates the discrepancies by listing data for the share of households in the emission of different gases. The home economics calculation is based on a rather narrow definition of household emissions, accounting e.g. for the direct emission of CO_2, mainly from burning fossil fuels. Neither the emissions for mobility (separate sector 'transport'), nor those for generating the electricity used in households (sector 'power plants') are included in this approach. Whereas direct SNA-based accounting includes the former but not the latter, accumulated SNA-based accounting includes both as emissions caused by households (Lorek et al., 1999). Additional but minor discrepancies result from the different data bases and base years used.

These discrepancies illustrate the need to clearly indicate the methodology used in any analysis. Even more importantly, data derived by different methodologies must be reported separately instead of mixing them when assessing the environmental impacts of household consumption. Unfortunately, this is frequently not the case, leading to a well-informed confusion rather than insight into the role of consumers for environmental disturbances.

2.2.1. SNA-based accounting

National economic accounting is based on the premise that goods and services are produced to meet demands of final users: production is no end in itself. Accordingly, all production efforts, upstream from the final consumption and including the resources consumed as well as the pollution released, can be allocated to specific final uses

Table 1
Household emissions 1992/93 as % of total emissions, different calculations

Emission into the atmosphere	Method of calculation		
	Direct[a] SNA-based	Accumulated[a] SNA-based	Household based[b]
CO_2	24	59	14
CO	58	73	15
NO_2	26	64	5
SO_2	6	57	7
CH_4	2	60	6
NMVOC	38	66	11

Source: Statistisches Bundesamt (1997), [a]1993 figures; [b]1992.

(private consumption, government consumption, fixed assets and exports).

However, governments' demands for goods and services also serve citizens' needs, e.g., the demand for security or education. Consequently, since public services are consumed privately, government consumption can be considered an intermediate with private consumption the final use. The argument is the same for fixed assets: since they are a necessary precondition for the production of consumer goods or intermediates in this or the next accounting period, they as well could be attributed to the final purpose of private consumption. Only an export surplus cannot be attributed to domestic consumption.

Consequently in any national economy all domestic environmental resource consumption minus the trade balance can be allocated to private consumers (including fixed assets and intermediates immediately, i.e., not in the next accounting periods only makes a minor difference). This is an unsatisfactory basis to determine the influence of households as state and business do not show up as influencing environmental impacts: their activities are considered to be totally demand driven. De facto, however, they influence the environmental impact by their own decisions (how to produce and provide goods and services) as well as through their influence on consumer decisions.

2.2.2. Home economics based accounting

Under this approach the environmental impact of households is assessed based on day-to-day consumer behaviour, in particular on the flow of consumer goods and the resulting stocks, e.g., of household appliances. The main items accounted for include domestic electricity and water consumption, purchases of products with environmental labels, and electrical appliances ownership. Upstream and downstream environmental impacts are not assessed but allocated to their immediate producers. The institutional setting and the different actors' spheres of influence are not reflected in this approach.

The information derived is used to develop green consumer guides, shopping lists and household consumption statistics (e.g., SustainAbility Ltd, 1994; UBA, 1994). This is the level typical to lifestyle debates, business advertising and campaigns of environmental and consumer NGOs.

Regarding household influence, this approach has two antagonistic flaws:

- the calculation systematically underestimates the households' outwards influence regarding upstream environmental impacts; while not dominating, households via their choice of products can have a significant impact throughout the production chain, and
- the calculation systematically overestimates the inward responsibilities of households, as no other actors are taken into account when assessing household decisions. Although 80–90% of the impacts of a product occur in the use phase, they are largely (more than 80%, Tischner, 2001) determined in the design phase (Thompson and Sherwin, 2001).

Consequently, due to the different kinds of biases, neither approach is capable of identifying

or even measuring the influence consumers have on the overall environmental stresses. Figures derived by both methodologies (as in Table 1) must be considered as seriously flawed.

2.3. Towards an alternative assessment methodology

Given the lack of an actors perspective in the SNA approach and the missing analysis of spheres of influence in the home economics methodology, none of them is suitable for the purpose of this study. The influence of households goes beyond the immediate environmental effect of their purchasing decisions, but plausibly does not determine the whole way the economy is operated.

The influence of consumers depends on a variety of variables. It differs between sectors and products/services (e.g., by closeness to the end-user or substitutability) and between consumption clusters (e.g., through different elasticities). Instead of trying to develop a new accounting scheme, this paper suggests to combine them. First the total environmental impact is assessed by SNA-based accounting, then the final use by households is disaggregated into ten activity-based consumption clusters. They are analysed to identify the respective spheres of influence.

Once a measure for the aggregated environmental impact is defined (Section 3), the environmentally relevant consumption clusters are identified and assessed regarding the respective level of control households have. The result will not be a full quantitative measurement of the environmental impact of households, but an assessment of their respective influence in those consumption clusters that dominate the environmental impact of consumption. This is also the precondition for identifying priorities and deriving appropriate indicators to monitor the reduction of environmental pressures from household consumption.

3. A methodology for monitoring the aggregate environmental impact of household consumption

In order to identify the environmentally most relevant consumption clusters, a methodology to monitor their total environmental burden is suggested.

3.1. Assessing life-cycle wide impacts

Any meaningful impact assessment must be based on a life-cycle approach. This applies to household consumption effects as to any other human-made environmental distortions.

Usually environmental stresses are characterised by the symptoms they cause, like climate change or acidification of freshwater, or by the pressures causing these symptoms, like greenhouse gas emissions and cation immissions. The simplification necessary for policy purposes is usually achieved by aggregation and by selection of core indicators (e.g., UK Government, 1999). This bottom–up aggregation is helpful but not sufficient to identify a few comprehensive driving forces to be monitored.

An alternative is a top–down analysis of environmental disturbance factors like monitoring the throughput or scale of the economy (Daly, 1996), providing a simplified, not symptom- or substance-specific approach (Spangenberg and Schmidt-Bleek, 1997). Before such a measure can be legitimately applied, however, it has to be shown that it leads to policy recommendations which, once implemented, would indeed help to solve most of the current environmental problems. Measuring the scale of the economy by physical throughput assessment can deliver such recommendations for all those problems that are not caused by the biochemical effects of small doses of specifically dangerous substances, including toxic and ecotoxic substances, as well as teratogenic, mutagenic and cancerogenic ones. Heavy metals, dioxins and some pesticides are well known examples of this kind of pressure. However, such substances are a classical field of public responsibility; most of them are legally regulated by bans or restrictions on production and use. Households may use them as they have used DDT in the past, but the environmental responsibility for their production and use is here allocated to the public authorities regulating these substances.

Table 2
The driving forces behind key environmental problems

Problem	Mechanism	Driving force
Climate change	CO_2 originates when organic materials are oxidised, mainly by burning fossil energy carriers	Energy consumption
	N_2O (nitrous oxide) originates from few industrial processes, but mainly from agriculture, often due to over-fertilisation	Land use
	CH_4 (methane) is emitted from rice paddies, cattle breeding	Land use
	and—dominant in industrialised countries—from waste dumps	Material flows
Ozone depletion	Ozone depletion is mainly caused by CFC emissions, phased out in most of Europe	(problem solved)
	Methylbromide is mainly used in intensive agriculture	Land use
Acidification	Acidification is caused by the immission of sulphur dioxide SO_2, ammonium NH_4 and nitrogen oxides NO_x	Energy consumption
	SO_2 originates mainly from the incineration of sulphur containing coal and crude oil but has diminished significantly	
	NH_4 originates from livestock production and manure management in intensive agriculture	Land use
	NO_x (NO and NO_2) originate spontaneously with each high-temperature energy release (incineration, industrial processes etc.)	Energy consumption
Eutrophication	Eutrophication is caused by the immission of bio-accessible phosphorus and nitrogen into terrestrial and limnic ecosystems. Today phosphates mainly originate from agriculture, where they are used as fertiliser	Land use
	Nitrate is emitted through mineral as well as organic fertilisation in intensive agriculture	Land use
Biodiversity loss	The most important pressures generate from intensive agriculture and forestry, from ecosystem	Land use
	fragmentation by infrastructure construction in particular for road transport, and from the mostly	Land use
	unintended introduction of foreign species as a result of global trade	Global trade
Soil erosion	Erosion of soil is caused by the growing mechanisation and single plant cultivation of intensive agriculture, by clear cutting of forests etc.	Land use
Inland water protection	The pollution of inland waters from industrial effluents and municipal waste water has been significantly reduced. The main source of water pollution today is the run off from	Land use
	intensive agriculture, plus acidifying inputs from long range air transport	Energy consumption
Waste problems	The total volume of waste is the material input into the economy minus flows stored in the stock plus flows from the	Material flows
	stock (e.g. construction waste), i.e. material inputs of earlier accounting periods. Waste water is the dominating waste flow in Northern economies	Material flows
Health risks	Overexposition to the health damaging effects of (mainly) small doses of toxic, mutagenic, teratogenic, cancerogenic or otherwise biologically active substances	Biological activity
Depletion of natural resources	Includes the exploitation of non-renewable resources like minerals and fossil fuels as well as to the overexploitation of renewables like the over harvesting e.g. of fish stocks	Land use, energy consumption, material flows

3.2. *Describing environmental pressures by measuring throughputs*

Household consumption like every human activity needs three kinds of physical resources: materials as its physical basis, energy for the processes and a realm where it takes place, i.e., area. Together they constitute the use of environmental space (Spangenberg, 1995), and the scale of consumption of these three key resource groups can serve as a first approximation of the pressures generated (Daly, 1991). Obviously if a reduction of input by e.g., a factor 10 (as suggested by Schmidt-Bleek, 1992a, 1994) were achieved, this 'physical

slimming' of the economy would *ceteris paribus* reduce environmental pressures on the output side, as energy consumption, material flows and land use intensity are the driving forces behind most of the current environmental problems, as Table 2 illustrates.

According to the respective national sustainability strategies, these problems are quite similar in almost all EU countries, comprising protection of the atmosphere (climate change, ozone depletion), acidification, eutrophication, safeguarding biodiversity, soil and inland water protection, waste problems, health risks and the depletion of natural resources (Grunwald et al., 2001). For most of these problems, strategies to moderate their effects have been developed, but e.g., for land degradation, waste generation, loss of biodiversity and greenhouse gas emissions, so far with little effect (Jänicke and Volkery, 2001).

Obviously, except for 'species transfer by global trade' and for 'biological activity', all other driving forces in Table 2 can be found to be based in energy consumption, material flows and unsustainable land use patterns. Unless these long-term driving forces of environmental degradation are directly addressed by altering the underlying socio-economic processes, only limited progress is to be expected. While the *economic value* of each product, is given by the market, the respective resource consumption determines the *environmental value* of each product including its 'ecological rucksack' (Schmidt-Bleek, 1994). The resulting money-matter dichotomy is as essential for ecological economics as the wave-particle dichotomy is for modern physics; once accepted, it calls for integrated physical-economic measurements as different from traditional ecology as from standard economics (Spangenberg et al., 2002).

A reduction in resource flows will not in all cases decrease the environmental pressures proportionally, but it is a directionally secure environmental objective, as there is a high probability that with decreasing resource consumption the level of environmental damages will be decreasing. Established strategies towards this goal include e.g., increasing energy efficiency, establishing closed loops for materials and shifting from intensive to organic agriculture, but more ambitious measures will be needed to reconcile the environment and the economy.

4. Consumption clusters—where can households make a difference?

As for all consumer goods, money and matter are two mostly independent variables; the identification of environmentally relevant consumption patterns needs to be based on physical, not on monetary data.

Consumption clusters will be considered of prior environmental importance as fields of household decision making if they are both environmentally relevant and under significant influence of consumers' choices. Those consumption clusters activating the most resource flows throughout the product life-cycle are taken to be the environmentally most relevant ones. The total household consumption is disaggregated into the ten consumption clusters known from earlier publications (BUND/MISEREOR, 1996; Adriaanse et al., 1997; Lorek and Spangenberg, 2001a). According to the accumulated SNA-based calculation they represent more than 95% of the household related resource consumption on the macro level. In alphabetical order they are:

- clothing: textiles for human use (i.e., not carpets),
- education/training: kindergartens, schools and universities,...
- food including food production, cooking, restaurants,...
- health care: hospitals, rehabilitation institutions,...
- housing: construction, maintenance, heating,...
- hygiene for the human body, washing, disinfecting,...
- laundry and cleaning of textiles,
- recreation: leisure activities without the transport involved,
- social life: police, military and other public services,
- transport: commercial transport, commuting and leisure related mobility.

Three clusters can be identified which—at least in the socioeconomic systems of continental Europe—primarily consist of state consumption: health care, education/training and social life. However, they provide services which are directly or indirectly consumed by private households, so that the resources they use can be considered as an upstream part of the household consumption. This also applies if the respective services are no longer produced by the public sector but are privatised and commercialised: households are still the final users constituting the same demand.

According to this definition, state consumption is part of the aggregated household consumption (neglecting the time-lag between the accounting periods of resource input and final consumption by the households). Households and individuals have a certain influence on the frequency and the intensity of use they make of these services, but this is rather limited. They can minimise the frequency of making use of medical services for preventive and curative purposes, but only to a certain degree. A minimum 'consumption' of education is legally regulated in most countries and all over Europe, and in the age of lifelong learning and the knowledge society even a higher level of education is considered essential. Finally, individuals have little choice regarding how much security 'produced' by the state they 'consume'.

Whereas there is still a limited influence of consumers on the number of these public services they consume, they have no choice regarding how these services are produced, partly due to lacking competition: in most countries citizens complain about a deficit, not a surplus of such services. The resource intensity of providing education, health care or safety is the indirect and accumulated result of a range of administrative decisions which can be influenced by public or private institutions e.g., by public procurement directives or insurance's health care standards, but not by household decisions. Since the resource consumption in these sectors is beyond the reach of consumer influence, they will be omitted from the further analysis of priorities for consumer action, regardless of their undisputed potential environmental significance.

The seven remaining clusters are not under complete household control, but at least household consumption decisions make a significant difference regarding their respective resource consumption. When analysing their respective share in environmental space consumption by means of physical input–output analysis, significant differences become obvious. The total resource requirement of only three clusters, construction and housing, food and nutrition, and transport and mobility makes up for nearly 70% of material extraction and energy consumption and more than 90% of land use. Each of these three clusters represents more than 15% of the total energy and material consumption (for detailed calculations see Lorek et al., 1999).

The remaining four clusters (hygiene, clothing, cleaning and recreation without transport) can be influenced by households, but they actually consume—if at all measured in detail—less than 5% of the aggregate resource consumption each. Given the relatively small share in resource consumption and the limited although significant influence of households e.g., on the resource intensity of clothing or cleaning agent production, 10% reduction of total resource consumption in these four clusters together seems to be a conservatively estimated maximum potential. Although this is not a quantity to be ignored, from a cost-effectiveness point of view these clusters are not considered priority fields of action.

Any analysis of the environmental impact of household consumption should focus on the priority clusters (Table 3), investigating them one by one regarding the actors involved and the key consumption decisions. As each cluster consists of a number of multi-component functionally equivalent consumptive systems, households cannot gradually increase and decrease their consumption. They have to decide whether to participate in a given system or seek an alternative (Cogoy, 1999). Consumptive systems consist of complementary goods where the use value of one is dependent on the availability of the other (like a car and gasoline). This makes it possible to define one or few indicators describing core characteristics of the system in a way that the indicator/s is/are representative for the whole of the system and its development direction. Such indicators for the three priority clusters are used when assessing the

Table 3
Where households can make a difference

Consumption clusters	Influence of private households	Environmentally relevance
Clothing	X	
Education/training		X
Food	X	X
Health care		X
Construction/housing	X	X
Hygiene	X	
Cleaning	X	
Recreation	X	
Social life		X
Transport	X	X

Source: Lorek et al. (1999).

spheres of influence of the different economic agents involved (Lorek and Spangenberg, 2001c).

5. The spheres of influence

The relative level of influence of the different actors depends on social and institutional settings determining their power position, on arguments (including the 435 bn $ turnover of the global advertising industry) and on the responsiveness of their respective audience to these arguments, which is influenced by a variety of intrinsic and extrinsic factors. The former comprise cognitive capacities, psychological factors, individual interests and philosophic or ethical norms, whereas the latter includes socioeconomic aspects like the disposable income and time availability, as well as social relations (self-esteem, respect, family bargaining). Intrinsic factors determine the preferences, while extrinsic ones reflect the economic, social and legal possibilities and constraints determining which preferences can be realised. As both overlap (e.g., individual preferences are shaped by social norms and relations and vice versa) no quantitative determination of the relative influence of both for the resulting behaviour is possible; they co-evolve (Hinterberger and Stewen, 2001).

Regarding household consumption, while extrinsic factors like disposable income have a significant influence on the availability of consumption options, intrinsic factors shape the choice between the alternatives available. One key factor determining such decisions is the individual assessment if existing alternatives are affordable in terms of purchasing power, time use preferences, resource endowment, social status and acceptability, legal and ethical constraints, etc. These factors need to play a key role when deriving policies to reduce the resource consumption of households. However, this is less relevant for the methodology developed in this paper, as it is no means to design policy measures but to monitor their effectivity.

The influence of actors was assessed by means of expert interviews and common sense reasoning, and was evaluated by a peer group from different fields of consumption policy and research. As such a process cannot provide quantitative information, an ordinal scale was used to characterise the relative influence of actors of certain decisions analysed, ranking from $++$ = dominating via $+$ = significant to 0 = marginal. An actors matrix was used illustrate the complex patterns of influence within each priority cluster.

As influence structures are specific to certain cultures and regions, the analysis developed in Germany is directly applicable to this country, and for the most of it to other continental European states. For affluent consumer societies outside continental Europe, this part of the analysis would have to be adjusted to the regional situation in order to provide comparable results.

For a validation of these estimates detailed social science studies following the logic suggested in this paper (accounting frames, relevance and influence criteria) would be required, taking into account these regional differences.

6. Case study on housing and construction

The methodology of analysing consumption clusters is illustrated here by using housing and

construction as a case study.

6.1. Relevance of the cluster

Energy consumption of housing accounts for 32% of the total demand, with heating representing 49% of the total households' energy consumption including passenger transport (GRE, 1997, p. 10).

Construction and housing causes 29% of the total material flows. This includes all raw materials and resources needed for the construction, extension and maintenance of apartments and houses including energy carriers for heating and materials used at the end of the life-cycle in order to demolish the building. Annually in Germany 500 millions of tons of sand, gravel and stones are mined (1990, data for Western Germany, Adriaanse et al., 1997. One hundred and forty-three of the 338 million tons of waste in Germany 1993, from UBA, 1997) originate from the construction industry (including road construction). To this, a significant share of the million tons overburden from mining per year has to be added, plus some of the production (total: 78 Mt) and the domestic waste (total: 44 Mt). Similar figures apply for most OECD countries (OECD, 2000, 2001).

The construction sector is the main contributor to the increasing sealing of soil, with 85% of the approved building projects in 1994 dedicated to housing. In a business-as-usual scenario, the total settlement area will increase by 370 km^2 until 2010 (Deutscher Bundestag, 1998), and 84% of this area will be used for single family houses.

6.2. Deriving indicators

The housing sector offers significant environmental opportunities to those households wanting to take action. Priority fields for action have been identified and can be monitored with a set of five indicators (for a discussion of the choice of individual indicators, see Lorek and Spangenberg, 2001a,b):

Indicator 1: Heating energy consumption (kW h/m^2 a)
Indicator 2: Resource intensity (kg/m^2 a)
Indicator 3: Living space (m^2/cap)
Indicator 4: Relation of private investment in existing houses to the erection of new buildings (dimensionless)
Indicator 5: Settlement area (m^2/cap)

6.3. The actors involved

Private households are important actors for a number of reasons, however to a different degree in different phases of planning, construction and use, and in interaction with different other actors:

- Nearly all housing expenditures (monetary and physical) can be attributed to private households, either as users or as property owners. If the households are owners as well as residents, their influence increases accordingly.
- Private households influence to a considerable extent the amount of material, energy and water needed for construction and residence, in particular by deciding about the apartment size and to some degree about housing modernisation.
- As owners, they decide about thermal insulation and the choice of more or less efficient heating systems.
- The patterns of airing and heating, and the preferred room temperature influence household energy consumption significantly, at an equivalent level of living comfort (up to a factor 2 due to different consumption behaviour). This way, residents can determine the amount of heating energy consumed by their consumption behaviour (and through minor renovations, e.g., for the sealing of joints).

A similar pattern of influence, like for private owners, is attributable to public or corporate owners of rentable flats. One important difference, however, is the investor–user-dilemma that occurs if the house owners' investments e.g., in energy saving benefit the resident and his/her energy bill, but not the investor. In these cases, energy service providers can help through contracting arrange-

ments by financing the investment and sharing the saving with residents and owners.

Local authorities significantly influence land use by dedicating specific areas for housing purposes and defining standards associated with building permits. Regional planners and architects influence settlement structure and area as well as the standards of construction (resource intensity).

Loan banks define funding criteria and thus influence the standard of housing—a capacity that could easily be extended to energy and material efficiency standards.

Political regulation frameworks and subsidies strongly influence the households' decisions whether to invest in the construction of new houses or whether to renovate old ones. Taxation of living area, material input and energy taxation, energy consumption standards play a significant role, as do criteria for granting subsidies. In Germany, public support for new developments was 27.1 bio DM in 1996, compared to 8.4 bio for upgrading existing houses.

The different but overlapping spheres of influence (but leaving out the time patterns of influence) is illustrated by the actors matrix in Table 4.

7. Discussion and conclusions

The methodology suggested for assessing the environmental impact of household consumption cannot deliver a single figure of how much influence is attributed to households. Instead it provides actors matrices that permit to depict the overlapping spheres of influence of different economic agents, thus illustrating their joint responsibilities.

The indicators developed can be applied to analyse other consumption-related question. For example they have been used to compare the environmental impact of household consumption of different income strata, identifying significantly higher environmental impacts for the high income group in all three priority clusters (Lorek and Spangenberg, 2001c).

Besides disposable income, skills, innovation, time budgets, commodity availability, substitution and preferences influence consumption choices. Taking them into account becomes even more essential when determining possible alternatives to or modifications of dominating consumption patterns, in particular when a choice of instruments needs to be made. The proper mix of administrative, economic, informational and other policy tools needs to take into account the socioeconomic factors described in Section 5 to be effective and the priority fields of action identified in this paper to be efficient.

As far as such behavioural changes result in economic savings, rebound effects will have to be taken into account. The role of free time should then be analysed as well; so far some perceive it as an consumption opportunity (provided scarcity of disposable money is not the bottleneck for con-

Table 4
Actors matrix for construction and housing

	Private households		Public owners	Corporate owners	Local authorities	Planners	Service providers
	Residents	Property owners					
Heating energy consumption	+	+	0	+	+	+	+
Resource intensity	0	+	0	+	+	+	+
Living space	++	+	+	+	+	+	0
Private investment in existing houses/ erection of new buildings	0	++	+	0	+	0	0
Settlement area	0	+	++	+	++	0	+

The influences are symbolised using an ordinal scheme with 0, little influence, +, significant influence, and ++, strong/dominating influence. *Source:* Lorek and Spangenberg (2001b).

sumption expenditures, Jalas, 2002), other consider it an opportunity for environmentally benign choices (Rinderspacher, 1996) or even a substitute to commodities (Cogoy, 1999; Scherhorn, 2000).

The concept developed in this paper can be applied to most affluent countries, and in particular to continental Europe. It is possible, however, to adapt the system of indicators to the diversity of country size, infrastructure, climate, heating etc. 'Tailor-made' indicators could be developed along the line of thought (consumption statistic derived prioritising) developed in the study presented here. Some further modification of the selection criteria for consumption clusters might be needed for other affluent countries due to global differences in wealth, preferences, consumption patterns, culture etc.

In any country, specifying the indicators and matrices according to the regional situation would make them even more helpful for political decision making. On the household level, they should already in the current version provide a suitable tool to guide the way from a *throw away society* (Packard, 1960) towards *eco-sufficiency* (Carley and Spapens, 1998) and *low impact affluence* (Sachs et al., 1998), at least for the citizens of Europe.

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