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

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12 **Abstract**

13
 14 Unsustainable consumption patterns of the North (or rather of the global affluent consumers class) have been
 15 identified by Agenda 21 as one of the key driving forces behind the unsustainable development. However, neither
 16 accounting based on the system of national accounts SNA nor household economics provide the proper instruments to
 17 assess the environmental impact of household decision making. Eco-efficiency assessments as familiar in the business
 18 sector provide no appropriate tool for households. As an alternative an environmental space based assessment scheme
 19 is suggested covering the major pressures on the environment caused by household decisions. The methodology is used
 20 twice, once to analyse the environmental relevance of the main activity clusters of household consumption and once to
 21 identify the dominant acts of consumption within each cluster. The latter provide the basis for deriving environmental
 22 performance indicators. A rough analysis of household influence potentials permits to identify housing, eating and
 23 mobility as the three priority fields for action for minimising the environmental impact of households. Extending the
 24 influence analysis actor matrixes are derived allocating influence and thus responsibility for environmental pressures to
 25 different groups of economic agents. © 2002 Published by Elsevier Science B.V.

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

27 **1. Introduction**

28 The need to reduce the environmental burden
 29 from consumption has come a long way from an
 30 exotic point of view when Vance Packard pub-
 31 lished 'The Waste Makers' (Packard, 1960), to an
 32 element of mainstream thinking. In 1992 the
 33 UNCED conference identified 'the unsustainable

34 *pattern of consumption and production, particularly*
 35 *in industrialised countries' to be a 'major cause*
 36 *of the continued degradation of the global environ-*
 37 *ment' (United Nations, 1993, chapter 4), and*
 38 *UNCSO undertook to develop guidelines and*
 39 *indicators for more sustainable such patterns*
 40 *(UNDESA, 1998). Nonetheless, the debate on*
 41 *the role of affluent consumers in the transition*
 42 *towards sustainability is as heated as ever. Some*
 43 *researchers (e.g. Schor, 1992) focus on the negative*
 44 *social, environmental and economic aspects of*
 45 *consumerism and consider compensatory con-*
 46 *sumption as an inferior substitute for a self-*

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47 determined life (Scherhorn, 1991). Others have
48 shown that high levels of consumption are not
49 necessarily irrational or misguided but a rational
50 behavioural pattern (Cogoy, 1999; Roepke, 1999).

51 Whatever the motivation, there is a consensus
52 that particular responsibility for the level, compo-
53 sition and impact of consumption rests with the
54 affluent inhabitants of Europe, North America
55 and Japan. They, and the thriving rich elite in the
56 transition countries and in the South (few as
57 compared to their population, but significant in
58 absolute figures) constitute a global consumer
59 class, with shared products, lifestyles and aspira-
60 tions (Robins and de Leeuw, 2001) and significant
61 environmental impacts. To identify their options
62 for effective damage-reducing action, a methodol-
63 ogy for assessing the environmental impact of
64 consumption from an *actors-centred perspective* is
65 needed. So far, there is neither any consensus on
66 what the necessary preconditions for changing
67 consumption patterns are (Schultz et al., 1999),
68 nor on how to measure the environmental impact
69 of households (we refer to households as social
70 entities with internal and external interactions as
71 opposed to the idea of the atomic consumer). Thus
72 it is rather undefined how influential households
73 are in determining the burden on the environment
74 (Jacobs and Ropke, 1999), resulting in widely
75 varying estimates.

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

88 The first systematic problem results from the
89 need for a standardised measure of the overall
90 environmental impacts. So far the measures sug-
91 gested have mainly been based on single sub-
92 stances or substance groups (fossil fuels, heavy
93 metals, air quality indices etc.), on aggregating
94 different impacts to one or few environmental

95 pressure indices (EuroStat, 1999) or on the con- 95
96 sumption of one specific resource. Examples for 96
97 the latter are exergy (usable low-entropy energy, 97
98 Ayres et al., 1996), material input per unit of 98
99 service (mips, Schmidt-Bleek, 1992a), and the 99
100 ecological footprint (Rees and Wackernagel, 100
101 1994). However, while due to their simplification 101
102 effect all these measures are helpful for commu- 102
103 nication purposes, the same effects renders them 103
104 less suitable for guiding decisions in households, 104
105 business and politics. 105

106 The definition of responsibility as proportional 106
107 to relative decision making power causes a second 107
108 systemic difficulty. Different (groups of) economic 108
109 agents occupy overlapping spheres of social, 109
110 economic and political influence in highly differ- 110
111 entiated and time-variant patterns. Power balances 111
112 can change from product to product, from region 112
113 to region and from time to time, making a 113
114 quantitative assessment of the relative influence 114
115 virtually impossible. Such a quantification of 115
116 influences, however, would be a precondition for 116
117 an allocation of environmental responsibilities to 117
118 specific actors like consumers. As a result of these 118
119 difficulties no scientifically rigorous macro level 119
120 allocation of responsibilities for the impacts of 120
121 consumption to specific groups of actors such as 121
122 households has not been developed so far. 122

123 The two currently used accounting frameworks, 123
124 based on the macroeconomic system of national 124
125 accounting and on home economics, respectively, 125
126 are not suitable for this purpose. The SNA 126
127 monitors financial flows (and in extended versions 127
128 resource flows and time consumption, Stahmer, 128
129 2000), regardless of who determined the size and 129
130 direction of flows. Home economics accounts for 130
131 production and consumption processes within the 131
132 household itself, thus neglecting the upstream 132
133 decisions they influence indirectly. Any attempt 133
134 to overcome this weakness, however, is faced with 134
135 the already mentioned impossibility to quantify 135
136 the roles of different economic agents in the 136
137 overlapping spheres of influence. Both accounting 137
138 frames can be applied using different numeraires 138
139 like money (e.g. Fukami, 1999), physical resources 139
140 (e.g. Ayres et al., 1996) or time (e.g. Cogoy, 1995). 140
141 Both methods are not able to adequately address 141
142 the relevance of household consumption for the 142

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143 total environmental impact, nor could any other
144 fixed accounting framework be. Instead in this
145 paper a stepwise approach is suggested:

- 146 1) identify the activity clusters comprising re-
147 source consumption ('consumption clusters')
148 of dominating environmental significance;
- 149 2) amongst them, identify those which are under
150 the control of households;
- 151 3) find the key decisions which dominate the
152 consumption cluster and identify the actors
153 responsible.

154 Only then can indicators be derived and sugges-
155 tions for reducing the environmental impact of
156 household consumption be made. By focusing on
157 the dominant clusters and the key decisions within
158 them this procedure avoids excessive collection
159 and processing of data on non-essential compo-
160 nents of household consumption or on impacts of
161 minor environmental relevance. Therefore it is
162 cost-effective in identifying priority fields of ac-
163 tion.

164 Section two of this paper introduces the new
165 methodology for an actors-centred analysis, com-
166 bining elements of SNA-based and home econom-
167 ics accounting and modifying them. A simple but
168 directionally secure measure of the overall envi-
169 ronmental impact is a necessary tool to analyse how
170 households could modify their consumption for
171 the benefit of the environment. In [Section 3](#) the
172 *environmental space* concept is suggested as such a
173 tool ([Opschoor and Costanza, 1993](#); [Spangenberg,
174 1995](#)).

175 The total consumption of environmental space
176 (energy, material, land) is subdivided into ten
177 consumption clusters such as housing, nutrition
178 and social life, together covering more than 95%
179 of the total resource consumption ([Lorek and Span-
180 genberg, 2001a](#)). For these clusters, environmental
181 space consumption is presented in [Section 4](#), based
182 on SNA-like physical input–output-tables. So the
183 environmentally relevant consumption clusters are
184 identified, however without providing information
185 on the respective responsibilities of the actors
186 involved. The analysis of actors for individual
187 consumption patterns is described in [Section 5](#),
188 resulting in a semi-quantitative actors matrix. The

spheres of influence identified are specific to the 189
institutional settings in the area under investiga- 190
tion, for the purpose of this study to Germany 191
(and similar in most of Western Europe). 192

In [Section 6](#), the analytical process is illustrated 193
in a case study on housing. [Section 7](#) concludes, 194
pointing to the possible use of the methodology 195
developed and the indicators derived for monitor- 196
ing change. It turns out that a quantitative 197
measurement of the environmental impact of 198
households is not possible, but spheres of influence 199
of households and other relevant actors can be 200
identified. 201

2. Measuring environmentally sustainable 202 household consumption 203

Despite the broad consensus regarding the need 204
to develop and support more sustainable con- 205
sumption patterns ([OECD, 1998](#); [UNDESA,
1998](#)), the areas in which households can make a 206
significant contribution to sustainable consump- 207
tion are still largely unexplored (e.g. [Cogoy, 1995](#);
208 [Haake and Kamminga, 2001](#)). So far, no coherent 209
actors-centred concept has been developed. 210
211

2.1. *Eco-efficiency: no measure for households* 212

Much of the *sustainable consumption debate* has 213
focussed on assessing the eco-efficiency of goods 214
and services in a life-cycle perspective ([WBCSD,
1999](#)). The impacts from production, use and 215
disposal of products are taken into account as 216
environmental costs, and the volume of services 217
delivered as benefits, measured e.g. as *mips*, 218
material input per service unit ([Schmidt-Bleek,
1994](#)). With a reduction of resource use per service 219
unit e.g. by a factor 10 or 4, even an increasing 220
consumption of services need not be unsustainable 221
([von Weizsäcker et al., 1997](#)). 222
223
224

Unfortunately, the definition of services in these 225
formulas is ambiguous, partly based on more 226
traditional concepts of unsustainable desires for 227
a maximum of utility ([Giarini, 1992](#)) and partly 228
extended to include factors exogenous to the neo- 229
classical model like the satisfaction from ethical 230
motives ([Stagl and O'Hara, 2001](#)). In either case, a 231

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232 certain act of consumption and the use of time,
 233 work and resources needed to make it happen are
 234 allocated to one specific purpose (not least to
 235 avoid double counting when trying to quantify
 236 household impacts). The environmental impact of
 237 the consumption act is then allocated to this
 238 motive when calculating the environmental burden
 239 stemming from fulfilling specific needs or wants.
 240 For example 100 km of transport is considered a
 241 service, and the impact of providing it by car or by
 242 rail can be compared (Schmidt-Bleek, 1994).

243 However, household decisions are hardly ever
 244 monocausal, but incorporate and react to a variety
 245 of influences and interests, all mutually influencing
 246 and modifying each other. Consequently, the
 247 utility from household consumption is not homo-
 248 genous and cannot be derived by aggregating
 249 single purchases. There is no direct micro–macro
 250 link, making it problematic to assess the total
 251 service derived from one household's consump-
 252 tion, let alone from all households' or consumers'.
 253 Therefore the methodology introduced here fo-
 254 cuses on absolute measurements, not on the
 255 relative impact per service and irrespective of the
 256 cost invoked or the time invested, as both can but
 257 need not be directly correlated with the environ-
 258 mental impact.

259 2.2. Households as actors—no frame for 260 accounting

261 Not only the allocation of certain decisions to a
 262 single motive is highly arbitrary, the allocation of
 263 responsibility for any such decision to the specific
 264 actors involved is problematic as well. However,
 265 successfully doing so for the household sector is an
 266 essential precondition for assessing its environ-
 267 mental impact.

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

270 • Macroeconomic accounting is based on the
 271 system of national accounts. Its input–output-
 272 tables with households as final users allocate the
 273 upstream expenditures for the production of
 274 consumption goods to this sector. It refers to
 275 flows, not to the agents activating them.

• Home economics assesses the production and 276
 consumption activities within the households, 277
 i.e. without taking upstream impact generation 278
 into account. In its extended version, it allocates 279
 the effects of each activity to the immediate 280
 actors, with no reference to reasons for and 281
 benefits from the respective activity. 282

In Germany, for example, the former approach 283
 is used by the Statistical Office, while the Environ- 284
 ment Agency usually refers to the latter one, with 285
 significantly differing results. Table 1 demon- 286
 strates the discrepancies by listing data for the 287
 share of households the emission of different 288
 gases. The home economics calculation is based 289
 on a rather narrow definition of household emis- 290
 sions, accounting e.g. for the direct emission of 291
 CO₂, mainly from burning fossil fuels. Neither the 292
 emissions for mobility (separate sector 'trans- 293
 port'), nor those for generating the electricity 294
 used in households (sector 'power plants') are 295
 included in this approach. Whereas direct SNA- 296
 based accounting includes the former but not the 297
 latter, accumulated SNA-based accounting in- 298
 cludes both as emissions caused by households 299
 (Lorek et al., 1999). Additional but minor dis- 300
 crepancies result from the different data bases and 301
 base years used. 302

These discrepancies illustrate the need to clearly 303
 indicate the methodology used in any analysis. 304
 Even more importantly, data derived by different 305
 methodologies must be reported separately instead 306
 of mixing them when assessing the environmental 307
 impacts of household consumption. Unfortu- 308
 nately, this is frequently not the case, leading to 309
 a well informed confusion rather than to insight 310
 into the role of consumers for environmental 311
 disturbances. 312

270 2.2.1. SNA-based accounting 313

National economic accounting is based on the 314
 premise that goods and services are produced to 315
 meet demands of final users: production is no end 316
 in itself. Accordingly, all production efforts, up- 317
 stream from the final consumption and including 318
 the resources consumed as well as the pollution 319
 released can be allocated to specific final uses 320

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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), ^a1993 figures; ^b1992.

321 (private consumption, government consumption, 353
322 fixed assets and exports). 354

323 However, governments' demands for goods and 355
324 services also serve citizens' needs, e.g. the demand 356
325 for security or education. Consequently, since 357
326 public services are consumed privately, govern- 358
327 ment consumption can be considered an inter- 359
328 mediate with private consumption the final use. 360
329 The argument is the same for fixed assets: since 361
330 they are a necessary precondition for the produc- 362
331 tion of consumer goods or intermediates in this or 363
332 the next accounting period, they as well could be 364
333 attributed to the final purpose of private con- 365
334 sumption. Only an export surplus cannot be 366
335 attributed to domestic consumption. 367

336 Consequently in any national economy all 368
337 domestic environmental resource consumption 369
338 minus the trade balance can be allocated to private 370
339 consumers (including fixed assets and intermedi- 371
340 ates immediately, i.e. not in the next accounting 372
341 periods only makes a minor difference). This is an 373
342 unsatisfactory basis to determine the influence of 374
343 households as state and business do not show up 375
344 as influencing environmental impacts: their activ- 376
345 ities are considered to be totally demand driven. 377
346 De facto, however, they influence the environ- 378
347 mental impact by their own decisions (how to 379
348 produce and provide goods and services) as well as 380
349 through their influence on consumer decisions. 381

350 2.2.2. Home economics based accounting

351 Under this approach the environmental impact 382
352 of households is assessed based on day-to-day 383

353 consumer behaviour, in particular on the flow of 354
355 consumer goods and the resulting stocks, e.g. of 356
357 household appliances. The main items accounted 358
359 for include domestic electricity and water con- 360
361 sumption, purchases of products with environ- 362
362 mental labels and electrical appliances ownership. 363
363 Upstream and downstream environmental impacts 364
364 are not assessed but allocated to their immediate 365
365 producers. The institutional setting and the differ- 366
366 ent actors' spheres of influence are not reflected in 367
367 this approach. 368

369 The information derived is used to develop 370
370 green consumer guides, shopping lists and house- 371
371 hold consumption statistics (e.g. *SustainAbility* 372
372 *Ltd*, 1994; *UBA*, 1994). This is the level typical 373
373 to lifestyle debates, business advertising and cam- 374
374 paigns of environmental and consumer NGOs. 375

376 Regarding household influence, this approach 377
377 has two antagonistic flaws: 378

- 379 • the calculation systematically underestimates 380
380 the households' outwards influence, regarding 381
381 upstream environmental impacts: while not 382
382 dominating, households via their choice of 383
383 products can have a significant impact through- 384
384 out the production chain, and 385
- 385 • the calculation systematically overestimates the 386
386 inwardly responsibilities of households, as no 387
387 other actors are taken into account when 388
388 assessing household decisions. Although 80– 389
389 90% of the impacts of a product occur in the 390
390 use phase, they are largely (more than 80%, 391
391 *Tischner*, 2001) determined in the design phase 392
392 (*Thompson and Sherwin*, 2001). 393

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386 Consequently, due to the different kinds of in
387 biases neither approach is capable of identifying or
388 even measuring the influence consumers have on
389 the overall environmental stresses. Figures derived
390 by both methodologies (as in [Table 1](#)) must be
391 considered as seriously flawed.

392 2.3. Towards an alternative assessment 393 methodology

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

403 The influence of consumers depends on a variety
404 of variables. It differs between sectors and pro-
405 ducts/services (e.g. by closeness to the end-user or
406 substitutability) and between consumption clusters
407 (e.g. through different elasticities). Instead of
408 trying to develop a new accounting scheme, this
409 paper suggests to combine them. First the total
410 environmental impact is assessed by SNA-based
411 accounting, then the final use by households is
412 disaggregated into ten activity-based consumption
413 clusters. They are analysed to identify the respec-
414 tive spheres of influence.

415 Once a measure for the aggregated environmen-
416 tal impact is defined ([Section 3](#)), the environmen-
417 tally relevant consumption clusters are identified
418 and assessed regarding the respective level of
419 control households have. The result will not be a
420 full quantitative measurement of the environmen-
421 tal impact of households, but an assessment of
422 their respective influence in those consumption
423 clusters that dominate the environmental impact
424 of consumption. This is also the precondition
425 for identifying priorities and deriving appropri-
426 ate indicators to monitor the reduction of
427 environmental pressures from household con-
428 sumption.

3. A methodology for monitoring the aggregate environmental impact of household consumption 429 430

In order to identify the environmentally most 431
relevant consumption clusters, a methodology to 432
monitor their total environmental burden is sug- 433
gested. 434

3.1. Assessing life-cycle wide impacts 435

Any meaningful impact assessment must be 436
based on a life-cycle approach. This applies to 437
household consumption effects as to any other 438
human-made environmental distortions. 439

Usually environmental stresses are characterised 440
by the symptoms they cause like climate change or 441
acidification of freshwater, or by the pressures 442
causing these symptoms like greenhouse gas emis- 443
sions and cation immissions. The simplification 444
necessary for policy purposes is usually achieved 445
by aggregation and by selection of core indicators 446
(e.g. [UK Government, 1999](#)). This bottom–up 447
aggregation is helpful but not sufficient to identify 448
a few comprehensive driving forces to be mon- 449
itored. 450

An alternative is a top–down analysis of 451
environmental disturbance factors like monitoring 452
the throughput or scale of the economy ([Daly, 453
1996](#)), providing a simplified, not symptom- or 454
substance-specific approach ([Spangenberg and 455
Schmidt-Bleek, 1997](#)). Before such a measure can 456
be legitimately applied, however, it has to be 457
shown that it leads to policy recommendations 458
which, once implemented, would indeed help to 459
solve most of the current environmental problems. 460
Measuring the scale of the economy by physical 461
throughput assessment can deliver such recom- 462
mendations for all those problems which are not 463
caused by the biochemical effects of small doses of 464
specifically dangerous substances, including toxic 465
and eco-toxic substances as well as teratogenic, 466
mutagenic and cancerogenic ones. Heavy metals, 467
dioxins and some pesticides are well known 468
examples of this kind of pressure. However, such 469
substances are a classical field of public responsi- 470
bility; most of them are legally regulated by bans 471
or restrictions on production and use. Households 472
may use them as they have used DDT in the past, 473

474 but the environmental responsibility for their
475 production and use is here allocated to the public
476 authorities regulating these substances.

477 3.2. Describing environmental pressures by 478 measuring throughputs

479 Household consumption like every human ac-
480 tivity needs three kinds of physical resources:
481 materials as its physical basis, energy for the
482 processes and a realm where it takes place, i.e.
483 area. Together they constitute the use of environ-
484 mental space (Spangenberg, 1995), and the scale of
485 consumption of these three key resource groups
486 can serve as a first approximation of the pressures
487 generated (Daly, 1991). Obviously if a reduction of
488 input by e.g. a factor 10 (as suggested by Schmidt-
489 Bleek, 1992a, 1994) were achieved, this ‘physical
490 slimming’ of the economy would *ceteris paribus*
491 reduce environmental pressures on the output side,
492 as energy consumption, material flows and land
493 use intensity are the driving forces behind most of
494 the current environmental problems, as Table 2
495 illustrates.

496 According to the national sustainability strate-
497 gies, these problems are quite similar in almost all
498 EU countries, comprising protection of the atmo-
499 sphere (climate change, ozone depletion), acidifi-
500 cation, eutrophication, safeguarding biodiversity,
501 soil and inland water protection, waste problems,
502 health risks and the depletion of natural resources
503 (Grunwald et al., 2001). For most of these
504 problems strategies to moderate their effects have
505 been developed, but e.g. for land degradation,
506 waste generation, loss of biodiversity and green-
507 house gas emissions so far with little effect
508 (Jänicke and Volkery, 2001).

509 Environmental policies minimising resource
510 throughput are considered directionally secure as
511 there is a high probability that with decreasing
512 resource consumption the level of environmental
513 damages will be decreasing. Obviously, except for
514 ‘species transfer by global trade’ and for ‘biologi-
515 cal activity’, all other driving forces can be found
516 to be based in energy consumption, material flows
517 and unsustainable land use patterns. Unless these
518 long term driving forces of environmental degra-
519 dation are directly addressed by altering the

underlying socio-economic processes, only limited 520
progress is to be expected. While the *economic* 521
value of each product is given by the market, the 522
respective resource consumption determines the 523
environmental value of each product including its 524
‘ecological rucksack’ (Schmidt-Bleek, 1994). The 525
resulting money-matter dichotomy is as essential 526
for ecological economics as the wave-particle 527
dichotomy is for modern physics; once accepted, 528
it calls for integrated physical-economic measure- 529
ments as different from traditional ecology as from 530
standard economics (Spangenberg et al., in press). 531

A reduction in resource flows will not in all 532
cases decrease the environmental pressures pro- 533
portionally, but it is a directionally secure envi- 534
ronmental objective. Established strategies towards 535
this goal include e.g. increasing energy efficiency, 536
establishing closed loops for materials and shifting 537
from intensive to organic agriculture, but more 538
ambitious measures will be needed to reconcile the 539
environment and the economy. 540

541 4. Consumption clusters—where can households 542 make a difference?

543 As for all consumer goods money and matter 544
are two mostly independent variables, the identi- 545
fication of environmentally relevant consumption 546
patterns needs to be based on physical, not on 547
monetary data.

548 Consumption clusters will be considered of prior 549
environmental importance as fields of household 550
decision making if they are both environmentally 551
relevant and under significant influence of con- 552
sumers’ choices. Those consumption clusters acti- 553
vating the most resource flows throughout the 554
product life-cycle are taken to be the environmen- 555
tally most relevant ones. The total household 556
consumption is disaggregated into the ten con- 557
sumption clusters known from earlier publications 558
(BUND/MISEREOR, 1996; Adriaanse et al., 559
1997; Lorek and Spangenberg, 2001a). According 560
to the accumulated SNA-based calculation they 561
represent more than 95% of the household related 562
resource consumption on the macro level. In 563
alphabetical order they are:

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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 ₂ O (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 and—dominant in industrialised countries—from waste dumps	Land use 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
Eutrophication	NO _x (NO and NO ₂) originate spontaneously with each high-temperature energy release (incineration, industrial processes etc.)	Energy consumption
	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
Biodiversity loss	Nitrate is emitted through mineral as well as organic fertilisation in intensive agriculture	Land use
	The most important pressures generate from intensive agriculture and forestry, from ecosystem fragmentation by infrastructure construction in particular for road transport, and from the mostly unintended introduction of foreign species as a result of global trade	Land use 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 intensive agriculture, plus acidifying inputs from long range air transport	Land use 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 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 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

- | | | | |
|-----|---|--|-----|
| 564 | ● clothing: textiles for human use (i.e. not carpets), | ● food including food production, cooking, restaurants,... | 568 |
| 565 | ● education/training: kindergartens, schools and universities,... | ● health care: hospitals, rehabilitation institutions,... | 569 |
| 566 | | | 570 |
| 567 | | | 571 |

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- 572 • housing: construction, maintenance, heating,...
- 573 • hygiene for the human body, washing, disin-
- 574 fecting,...
- 575 • laundry and cleaning of textiles,
- 576 • recreation: leisure activities without the trans-
- 577 port involved,
- 578 • social life: police, military and other public
- 579 services,
- 580 • transport: commercial transport, commuting
- 581 and leisure related mobility.

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

594 According to this definition state consumption
 595 is part of the aggregated household consumption
 596 (neglecting the time-lag between the accounting
 597 periods of resource input and final consumption
 598 by the households). Households and individuals
 599 have a certain influence on the frequency and the
 600 intensity of use they make of these services, but
 601 this is rather limited. They can minimise the
 602 frequency of making use of medical services for
 603 preventive and curative purposes, but only to a
 604 certain degree. A minimum ‘consumption’ of
 605 education is legally regulated in most countries
 606 and all over Europe, and in the age of life long
 607 learning and the knowledge society even a higher
 608 level of education is considered essential. Finally,
 609 individuals have little choice regarding how much
 610 security ‘produced’ by the state they ‘consume’.

611 Whereas there is still a limited influence of
 612 consumers on the number of these public services
 613 they consume, they have no choice regarding how
 614 these services are produced, partly due to lacking
 615 competition: in most countries citizens complain
 616 about a deficit, not a surplus of such services. The
 617 resource intensity of providing education, health
 618 care or safety is the indirect and accumulated

619 result of a range of administrative decisions which
 620 can be influenced by public or private institutions
 621 e.g. by public procurement directives or insuran-
 622 ce’s health care standards, but not by household
 623 decisions. Since the resource consumption in these
 624 sectors is beyond the reach of consumer influence,
 625 they will be omitted from the further analysis of
 626 priorities for consumer action, regardless of their
 627 undisputed potential environmental significance.

628 The seven remaining clusters are not under
 629 complete household control, but at least house-
 630 hold consumption decisions make a significant
 631 difference regarding their respective resource con-
 632 sumption. When analysing their respective share in
 633 environmental space consumption by means of
 634 physical input–output analysis, significant differ-
 635 ences become obvious. The total resource require-
 636 ment of only three clusters, construction and
 637 housing, food and nutrition and transport and
 638 mobility makes up for nearly 70% of material
 639 extraction and energy consumption and more than
 640 90% of land use. Each of these three clusters
 641 represents more than 15% of the total energy and
 642 material consumption (for detailed calculations see
 643 Lorek et al., 1999).

644 The remaining four clusters (hygiene, clothing,
 645 cleaning and recreation without transport) can be
 646 influenced by households, but they actually con-
 647 sume—if at all measured in detail—less than 5%
 648 of the aggregate resource consumption each.
 649 Given the relatively small share in resource con-
 650 sumption and the limited although significant
 651 influence of households e.g. on the resource
 652 intensity of clothing or cleaning agent production,
 653 10% reduction of total resource consumption in
 654 these four clusters together seems to be a con-
 655 servatively estimated maximum potential.
 656 Although this is not a quantity to be ignored,
 657 from a cost-effectiveness point of view these
 658 clusters are not considered priority fields of action.

659 Any analysis of the environmental impact of
 660 household consumption should focus on these
 661 priority clusters (Table 3), investigating them one
 662 by one regarding the actors involved and the key
 663 consumption decisions. As each cluster consists of
 664 a number of multi-component functionally equiva-
 665 lent consumptive systems, households cannot
 666 gradually increase and decrease their consump-

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).

667 tion. They have to decide whether to participate in
668 a given system or seek an alternative (Cogoy,
669 1999). Consumptive systems consist of comple-
670 mentary goods where the use value of one is
671 dependent on the availability of the other (like a
672 car and gasoline). This makes it possible to define
673 one or few indicators describing core character-
674 istics of the system in a way that the indicator/s is/
675 are representative for the whole of the system and
676 its development direction. Such indicators for the
677 three priority clusters are used when assessing the
678 spheres of influence of the different economic
679 agents involved (Lorek and Spangenberg, 2001c).

680 5. The spheres of influence

681 The relative level of influence of the different
682 actors depends on social and institutional settings
683 determining their power position, on arguments
684 (including the 435 bn \$ turnover of the global
685 advertising industry) and on the responsiveness of
686 their respective audience to these arguments,
687 which is influenced by a variety of intrinsic and
688 extrinsic factors. The former comprise cognitive
689 capacities, psychological factors, individual inter-
690 ests and philosophic or ethical norms, whereas the
691 latter includes socio-economic aspects like the
692 disposable income and time availability as well as
693 social relations (self-esteem, respect, family bar-

gaining). Intrinsic factors determine the prefer- 694
ences, while extrinsic ones reflect the economic, 695
social and legal possibilities and constraints deter- 696
mining which preferences can be realised. As both 697
overlap (e.g. individual preferences are shaped by 698
social norms and relations and vice versa) no 699
quantitative determination of the relative influence 700
of both for the resulting behaviour is possible; they 701
co-evolve (Hinterberger and Stewen, 2001). 702

Regarding household consumption, while extr- 703
insic factors like disposable income have a 704
significant influence on the availability of con- 705
sumption options, intrinsic factors shape the 706
choice between the alternatives available. One 707
key factor determining such decisions is the 708
individual assessment if existing alternatives are 709
affordable in terms of purchasing power, time use 710
preferences, resource endowment, social status and 711
acceptability, legal and ethical constraints, etc. 712
These factors need to play a key role when deriving 713
policies to reduce the resource consumption of 714
households. However, this is less relevant for the 715
methodology developed in this paper, as it is no 716
means to design policy measures but to monitor 717
their effectivity. 718

The influence of actors was assessed by means of 719
expert interviews and common sense reasoning, 720
and was evaluated by a peer group from different 721
fields of consumption policy and research. As such 722
a process cannot provide quantitative information, 723
an ordinal scale was used to characterise the 724
relative influence of actors of certain decisions 725
analysed, ranking from +++ = dominating via + 726
= significant to 0 = marginal. An actors matrix 727
was used illustrate the complex patterns of influ- 728
ence within each priority cluster. 729

As influence structures are specific to certain 730
cultures and regions, the analysis developed in 731
Germany is directly applicable to this country, and 732
for the most of it to other continental European 733
states. For affluent consumer societies outside 734
continental Europe this part of the analysis would 735
have to be adjusted to the regional situation in 736
order to provide comparable results. 737

For a validation of these estimates or—even 738
more ambitious—for their quantification detailed 739
social science studies following the logic suggested 740
in this paper (accounting frames, relevance and 741

742 influence criteria) would be required, taking into
743 account these regional differences.

744 6. Case study on housing and construction

745 The methodology of analysing consumption
746 clusters is illustrated here by using housing and
747 construction as a case study.

748 6.1. Relevance of the cluster

749 Energy consumption of housing accounts for
750 32% of the total demand, with heating represent-
751 ing 49% of the total households' energy consump-
752 tion including passenger transport (GRE, 1997, p.
753 10).

754 Construction and housing causes 29% of the
755 total material flows. This includes all raw materials
756 and resources needed for the construction, exten-
757 sion and maintenance of apartments and houses
758 including energy carriers for heating and materials
759 used at the end of the life-cycle in order to
760 demolish the building. Annually in Germany 500
761 millions of tons of sand, gravel and stones are
762 mined (1990, data for Western Germany,
763 (Adriaanse et al., 1997). One hundred and forty
764 three of the 338 million tons of waste in Germany
765 (1993), from UBA, 1997) originate from the
766 construction industry (including road construc-
767 tion). To this, a significant share of the million
768 tons overburden from mining per year has to be
769 added, plus some of the production (total: 78 Mt)
770 and the domestic waste (total: 44 Mt). Similar
771 figures apply for most OECD countries (OECD,
772 2000, 2001).

773 The construction sector is the main contributor
774 to the increasing sealing of soil, with 85% of the
775 approved building projects in 1994 dedicated to
776 housing. In a business-as-usual scenario, the total
777 settlement area will increase by 370 km² until 2010
778 (Deutscher Bundestag, 1998), and 84% of this area
779 will be used for single family houses.

780 6.2. Deriving indicators

781 The housing sector offers significant environ-
782 mental 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/m² a) 788

Indicator 2: Resource intensity (kg/m² a) 789

Indicator 3: Living space (m²/cap) 790

Indicator 4: Relation of private investment in
existing houses to the erection of new buildings
(dimensionless) 791

Indicator 5: Settlement area (m²/cap) 792

793

6.3. The actors involved 794

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: 795

- Nearly all housing expenditures (monetary and
physical) can be attributed to private house-
holds, either as users or as property owners. If
the households are owners as well as residents,
their influence increases accordingly. 799
- Private households influence to a considerable
extent the amount of material, energy and water
needed for construction and residence, in parti-
cular by deciding about the apartment size and
to some degree about housing modernisation. 800
- As owners, they decide about thermal insula-
tion and the choice of more or less efficient
heating systems. 801
- The patterns of airing and heating, and the
preferred room temperature influence house-
hold 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). 802

A similar pattern of influence like for private
owners is attributable to public or corporate 821

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823 owners of rentable flats. One important difference,
824 however, is the investor–user-dilemma that occurs
825 if the house owners' investments e.g. in energy
826 saving benefit the resident and his/her energy bill,
827 but not the investor. In these cases, energy service
828 providers can help through contracting arrange-
829 ments by financing the investment and sharing the
830 saving with residents and owners.

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

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

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

851 The different but overlapping spheres of influ-
852 ence (but leaving out the time patterns of influ-
853 ence) is illustrated by the actors matrix in Table 4.

7. Discussion and conclusions

854

855 The methodology suggested for assessing the
856 environmental impact of household consumption
857 cannot deliver a single figure of how much
858 influence is attributed to households. Instead it
859 provides actors matrices that permit to depict the
860 overlapping spheres of influence of different eco-
861 nomic agents, thus illustrating their joint respon-
862 sibilities.

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

871 Besides disposable income, skills, innovation,
872 time budgets, commodity availability, substitution
873 and preferences influence consumption choices.
874 Taking them into account becomes even more
875 essential when determining possible alternatives to
876 or modifications of dominating consumption pat-
877 terns, in particular when a choice of instruments
878 needs to be made. The proper mix of adminis-
879 trative, economic, informational and other policy
880 tools needs to take into account the socio-eco-
881 nomic factors described in Section 5 to be effective
882 and the priority fields of action identified in this
883 paper to be efficient.

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).

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884 As far as such behavioural changes result in
885 economic savings, rebound effects will have to be
886 taken into account. The role of free time should
887 then be analysed as well; so far some perceive it as
888 an consumption opportunity (provided scarcity of
889 disposable money is not the bottleneck for con-
890 sumption expenditures, [Jalas, 2002](#)), other con-
891 sider it an opportunity for environmentally benign
892 choices ([Rinderspacher, 1996](#)) or even a substitute
893 to commodities ([Cogoy, 1999](#); [Scherhorn, 2000](#)).

894 The concept developed in this paper can be
895 applied to most affluent countries, and in parti-
896 cular to continental Europe. It is possible, how-
897 ever, to adapt the system of indicators to the
898 diversity of country size, infrastructure, climate,
899 heating etc. ‘Tailor-made’ indicators could be
900 developed along the line of thought (consumption
901 statistic derived prioritising) developed in the
902 study presented here. Some further modification
903 of the selection criteria for consumption clusters
904 might be needed for other affluent countries due to
905 global differences in wealth, preferences, consump-
906 tion patterns, culture etc.

907 In any country, specifying the indicators and
908 matrices according to the regional situation would
909 make them even more helpful for political decision
910 making. On the household level, they should al-
911 ready in the current version provide a suitable
912 tool to guide the way from a *throw away society*
913 ([Packard, 1960](#)) towards *eco-sufficiency* ([Carley](#)
914 [and Spapens, 1998](#)) and *low impact affluence*
915 ([Sachs et al., 1998](#)), at least for the citizens of Eur-
916 ope.

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