The Impacts of Household Consumption and Options for Change

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Summary

This introductory article situates the contributions that comprise this special issue within the field of sustainable consumption and production (SCP) studies. After a brief review of the policy history surrounding SCP, we organize our discussion and the subsequent collection of articles into two groups. The first suite of articles views the environmental impacts associated with household consumption from the perspectives of different consumer groups, income levels, and geographic areas. This work confirms and refines several insights that have been developing over the past several years, namely that food and beverages, mobility, housing, and energy-using products are the most critical consumption domains from the standpoint of environmental sustainability and that higher household income leads to greater (but less than proportional) impacts. The second subset of articles analyzes the potential for mitigating these impacts through behavioral changes and innovation strategies. Although the contributions to this special issue describe several noteworthy examples of information- and team-based initiatives to catalyze behavioral changes, the state of knowledge pertaining to this aspect of the consumption problem is much more inchoate. Research on the formulation and implementation of effective "change management for sustainable consumption" should be treated as an area of priority attention for industrial ecologists.

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Introduction

James Gustave Speth (2008), former head of the United Nations Development Program and retired dean of the Yale School of Forestry and Environmental Studies, begins his widely acclaimed book *The Bridge at the Edge of the World* with a sobering summary of findings predicated on authoritative ecological assessments:

> Half the world's tropical and temperate forests are now gone. . . . About half the wetlands and a third of the mangroves are gone. . . . An estimated 90 percent of the larger predator fish are gone, and 75 percent of the marine fisheries are now overfished or fished to capacity. . . . Species are disappearing at rates about a thousand times faster than normal. . . . Over half of the agricultural land in drier regions suffers from some degree of deterioration and desertification. Persistent toxic chemicals can now be found by the dozens in essentially each and everyone of us. (1)

This dour appraisal is just one of the many recent warnings that the economy as we know it is "crashing against the Earth" (Speth 2008, 1: see also MEA 2005; see also IPCC 2007; Stern 2007). The application of analytical tools such as ecological footprint analysis has demonstrated that global resource use became unsustainable (in the sense that people are using more resources than the planet can provide) in the mid-1980s, and the trend has evinced no reduction since that time (NEF 2006). Researchers often assert that if the entire global population consumed natural resources at European levels, three planets would be required to support the massive flow of energy and materials. More striking, if global per capita consumption was on par with that of the United States, more than five planets would be necessary (WWF 2006). The International Energy Agency (2009) forecasts that in the absence of vigorous policy action to limit carbon dioxide (CO_2) releases, annual global emissions will rise from 28 gigatons (Gt) in 2006 to 65 Gt in 2050. This amount is well above the 5 Gt per annum that both the International Panel on Climate Change (2007) and the Stern Report (2007) regard as mandatory targets to limit global temperatures from crossing parlous thresholds. It is becoming increasingly clear that the environmental impacts related to contemporary modes of consumption and production have to be reduced, in some cases in radical ways. With respect to CO_2, we likely need to aim for a factor 10 or more decarbonization of the economic system (e.g., Jackson, 2009).

In addition to the challenge of climate change, several other issues are prominent on the international policy agenda, and efforts to address them, in principle, could catalyze political action. Already at the 1992 Earth Summit in Rio de Janeiro, national governments recognized that the problems inherent in contemporary modes of consumption and production, in particular the prevalent systems in place in the industrialized countries, impose the greatest burdens on the earth's capacity to satisfy human needs and desires (UNDESA 1992). Broad agreement on this point led to an appeal for more sustainable patterns of consumption and production as part of Agenda 21, and this commitment was reaffirmed at the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg. At the latter event, delegates called on the United Nations Environment Program (in collaboration with the United Nations Department of Economic and Social Affairs) to formulate a ten-year framework of programs on Sustainable Consumption and Production (SCP) as part of the Johannesburg Plan of Implementation (UNDESA 2002).

This article is not the place for a comprehensive review of SCP policy history (see, e.g., Fuchs and Lorek 2005; de Wit 2006; Tukker 2010; Cohen 2010), but in the years since the conference in South Africa, the international SCP agenda has gained political salience with, for instance, the development of SCP action plans for Africa and Europe (African Experts Meeting 2005; European Commission 2008) and the issuance of a steady stream of national strategy documents (e.g., UK DEFRA 2003; Finnish Ministry of the Environment 2005; German Federal Environment Agency 2007). The rate of progress with respect to implementation has invariably been incremental, and this slow pace is at odds with the ambitious changes that many scientific organizations, secondary policy-making bodies, and nongovernmental organizations (NGOs)

contend is needed (OECD 1997; Royal Society and US NAS 1997; NEF 2006).

This special issue of the *Journal of Industrial Ecology* stems in part from a major European Union–funded project—Sustainable Consumption Research Exchanges (SCORE)—that provided a support network during preparations of the international 10-year framework of programs (the so-called Marrakech Process). This collection comprises substantially revised versions of papers originally presented in Brussels at the culminating conference of the SCORE initiative in March 2008 as well as other contributions assembled through a targeted public solicitation. In this overview, we first identify the connections between industrial ecology and SCP, and we introduce the three articles in this special issue that speak directly to the global environmental impacts of household consumption. We then describe various policy strategies to influence changes in prevailing consumption patterns and highlight a further five contributions that consider these challenges. The conclusion outlines several strategies for more effectively exploiting the linkages between industrial ecology and SCP in the future.

Industrial Ecology and SCP

More sustainable patterns of consumption and production can be realized through various interventions in the economic system.[1] Figure 1 classifies these different leverage points by following a prototypical product chain from resource extraction to final consumption.[2] These strategies comprise the following:

- *greening production* by reducing the impact intensity of mining and manufacturing activities through the implementation of end-of-pipe measures or structural technical changes in production methods,
- *greening products and services* by decreasing material and energy use per functional unit,
- *intensifying use* by encouraging more efficient deployment of products and services (e.g., by promoting activities such as carpooling),
- *greening consumption patterns* by shifting expenditures to lower impact product and service alternatives, and
- *reducing consumption volumes* while maintaining quality of life.

Of particular interest from the standpoint of industrial ecology is that the efficacy of strategies at these various intervention points can be assessed with environmentally extended input–output analysis (EE-IOA; Leontief and Ford 1970; Forsund 1985; Miller and Blair 1985; Forssell 1998; Hertwich 2005b). In brief, an (industry-by-industry) input–output table (IOT) describes the monetary value of purchases by an industry from each other industry (and, hence, the sales from each industrial sector to each other industrial sector) as well as purchases by final consumers. The environmental extensions (EE) of the IOT express the primary material inputs and emission outputs of each industry in a satellite account. For each final consumption category, it is possible to determine the additional value contributed by each industry and, if one assumes a proportional allocation of the EE, estimate the

Production side *Eco-efficiency strategies*			Consumption side *Sufficiency strategies*	
Mining and manufactuing	Design and fabrication of products and services	Use of products and services	Expenditure mix	Quality of life realized
End-of-pipe and cleaner production	*Greening products*	*Intensifying use (product-service systems)*	*Enhancing immaterial consumption or reducing consumption*	*Improving quality of life per unit expenditure*

Figure 1 Intervention points to realize sustainable consumption and production patterns.

total emissions and resource uses for each final consumption category.

One can also use this general approach to analyze the consumption-related environmental impacts of specific consumer groups, geographic regions, and other discrete populations. EE-IOA quantifies how each of the mechanisms detailed in figure 1 might help lower the overall environmental impacts of final consumption. First, end-of-pipe measures or cleaner production technologies reduce EE per unit of added value in an industry. Second, the greening of products implies that goods from a final consumption category could be produced with fewer inputs from (material- and energy-intensive) industries. Third, more intensive use implies that consumers require fewer final products and services, which thus suggests a reduction in production and, hence, environmental impacts associated with the production system. Fourth, shifting demand to more environmentally benign consumption categories reduces the production of impact-intensive industrial sectors. Finally, decreased consumer demand lowers overall production levels and, hence, reduces impacts. Three of the articles in this special issue variously use EE-IOA to analyze the impacts of final consumption or effects of improvement measures on it.

Aside from critical questions pertaining to how environmental impacts are *related* to consumption, there is a clear policy need to understand how to bring about *changes* in patterns of consumption and production. Given the urgency outlined above, such challenges probably require even more pressing final analytical refinement. Industrial ecologists have displayed over the years a frustrating tendency to sidestep issues related to the need to foster fundamental changes in consumption practices (Cohen and Howard 2006; Salmi and Toppinen 2007; Røpke 2009).[3] Studies related to the modification of consumer practices have been more readily pursued by scholarship in collateral fields, such as policy studies (Sondeijker et al. 2006), innovation studies (Geels 2005), and consumer studies (Fuchs and Lorek 2005; Cohen 2006; Yates 2008).

An interesting development, though, is that changes consistent with many of the recommendations advanced under the rubric of SCP are increasingly being viewed as emblematic of "sustainability transitions" or "system innovations" (Tukker et al. 2008; Grin et al. 2009). The conceptual approaches used in this work include actor-network theory (ANT; Latour 1987; Callon, 1998), innovation system theories (Tukker 2005; Andersen 2008), evolutionary economics (Nelson and Winter 1982; Mulder and van den Bergh 2001), and complex system theories (Meadows 1999; Kemp et al. 2007; Loorbach and Rotmans 2009). It is especially notable that the latter two fields deploy illustrative images that are closely aligned with the industrial ecology metaphor (see, e.g., Ehrenfeld 2007). The incorporation of these evolutionary and complex-systems perspectives into key concepts that inform industrial ecology is likely to be a useful avenue of future inquiry (cf. van den Bergh and Stagl, 2004), a point about which we have more to say in the conclusion.

Impacts of Final Consumption

Introduction

Researchers initially undertook studies to assess the environmental impacts of final consumption during the 1970s, when the first wave of oil crises sparked the need for information on how to most effectively reduce energy use (Bullard and Herendeen 1975; Herendeen and Tanaka 1976; Boustead and Hancock 1979). With broader development and application of life cycle analysis (LCA) during the 1990s and expanded interest in EE-IOA since 2000, numerous studies have been amassed on the relationship between environmental impacts and household consumption (Stern et al. 1997; Lenzen 1998; Munksgaard et al. 2000; Weber and Perrels 2000; Wier et al. 2001; Hubacek et al. 2009). Important recent reviews of this work from standpoints relevant to industrial ecology include the article by Hertwich (2005a) and two special issues of the *Journal of Industrial Ecology* (one on industrial ecology and sustainable consumption in 2005, and a second one on the environmental impacts of products in 2006).[4] We first review the key findings of this research and then highlight the relevant contributions in this special issue.

Factors Determining Impacts of Final Consumption

Priority Consumption Domains

A first important methodological step in the move toward SCP is to identify the priority areas to which policy attention should be devoted. Over the past decade, a series of comprehensive studies and related reviews have investigated the life cycle environmental impacts of final consumption expenditures in several countries, including Belgium, Norway, the Netherlands, the EU25 countries, and the United States (Suh 2004; EEA, 2005; Hertwich 2005a; Weidema et al. 2005; Tukker 2006; Tukker et al. 2006a; Moll et al. 2008).

The variety of approaches used to analyze the environmental impacts of products is immense. Investigators have focused on different geographical areas, ranging from the local to the global; different pollutants and resources; and various product clusters. This research has entailed the deployment of fundamentally different data-inventory methods (i.e., bottom-up LCA or top-down IOA) and has used a range of measures to gauge impacts. Some of these analyses have been predicated on outmoded data sets, and this has especially been the case in studies based on national accounts. Despite these variations and inevitable shortcomings, the main findings of this body of work are clear and consistent. *Mobility* (automobile and air transport, including holiday travel), *food* (meat and dairy, followed by the other foodstuffs), and *home building and demolition* (including the use of *energy-using products* [EuPs]) are responsible for the largest proportion of consumption-related environmental impacts. These domains, in aggregate, account for 70% to 80% of the life cycle environmental impacts in industrialized countries and thus should arguably be the focus of policy interventions. The conclusion is unambiguous. If priorities (from an environmental perspective) have to be set, SCP programs should focus on mobility (including tourism), food, housing, and EuPs.

Determining Variables

Several of the studies cited above have also analyzed the factors responsible for the (sometimes large) differences in the environmental impacts generated by different individuals and households. The explanatory variables that emerge from this work include the following:

- *Income*: Environmental impacts rise with household income, because increasing affluence enables consumers to use more energy and to acquire larger volumes of material goods. This escalation, however, tends to be slightly less than proportional due to the fact that as income increases, consumption expenditures become more heavily geared toward more lavish products. In general, luxury goods generate smaller additional impacts per monetary unit in comparison with goods designed to meet basic needs, although it is clear that CO_2 emissions expand in absolute terms with increasing income (Druckman and Jackson 2008; Weber and Matthews 2008b; Kerkhof et al. 2009). A growing body of literature, however, questions whether the impacts of increasing household consumption are less than proportional with income (e.g., Baiocchi et al. 2009).
- *Household size*: Per capita environmental impacts vary inversely with household size because people living under the same roof share energy-using appliances and cohabitants tend to require less individual living space (and related heating and cooling demands) than single household occupants (Weber and Matthews 2008b). A generally positive correlation exists between household size and emissions in absolute terms, however. These analyses lead to two important observations—growing populations and decreasing household sizes both lead to increases in emissions (Liu et al. 2003; Wilson and Boehland 2005).
- *Location*: Urban residents are typically responsible for fewer overall environmental impacts than people living in suburbs or rural communities.[5] This phenomenon is attributable to two primary factors. First, urban dwellings are generally smaller and, due to higher building densities, have less exposed surface area than suburban

homes, which leads to lower residential heating and cooling requirements. Second, suburbanites and rural residents usually have high automobile dependency because of relatively low-density settlement patterns. Denser population distributions support the concentration of commercial services, such as shopping facilities, which create positive feedback loops and reduce reliance on car transportation (e.g., Ewing and Cervero 2001; Sanne 2002; Jackson 2003).

- *Automobile ownership*: Given that mobility is responsible for a substantial proportion of the environmental impacts that emanate from household consumption, people who use public transportation on a regular basis generally have, ceteris paribus, smaller footprints. An important caveat, however, arises from the fact that public transportation tends to be less expensive than automobile ownership, and final determination of comparative environmental efficacy depends on whether the savings are spent on comparatively lower impact-intensive consumption categories (Ornetzeder et al. 2008).
- *Food consumption patterns*: Vegetarians and consumers who eat locally harvested, seasonal, or organic food generally have lower per capita environmental impacts than individuals who rely on more customary diets (Duchin 2005; Foster et al. 2006; Tara 2008; Weber and Matthews 2008a; Tukker et al. 2009). Assessment gets more complicated, however, when one compares local fruits and vegetables produced in energy-intensive greenhouses with the "food miles" accrued by field-grown alternatives from distant locations (Blanke and Burdick 2005; Pretty et al 2005). Under such circumstances, it is difficult to formulate unambiguous heuristics.
- *International (and interregional) trade*: Recent decades have seen the large-scale relocation of production from developed to developing nations. Less-efficient production technologies tend to be deployed at facilities located in industrializing countries, and this pattern of economic reorganization has increased the supply-chain environmental impacts of household consumption (Minx and Baiocchi 2009; see also Strømman et al 2009). These environmental impacts have been documented through the use of a variety of metrics, including ecological footprint analysis and virtual water flow analysis (Chapagain et al. 2006; Hoekstra and Chapagain 2007; van Oel et al 2009).
- *Social and cultural differences*: Going back at least as far as the work of Erickson (1997), researchers have recognized the variation that exists in energy consumption across countries of similar incomes. In terms of greenhouse-gas emissions, research has drawn on this perspective to highlight the disparity that prevails between, say, the United States (per capita CO_2 equals approximately 20 metric tons) and the United Kingdom (per capita CO_2 equal approximately 9.5 metric tons). Although some of this variability can be attributed to population density, infrastructure, and so forth, it is also important to recognize how different social and cultural predispositions temper prevalent understandings pertaining to the use of energy and materials (Maréchal 2009; Sovacool, in press).
- *Geographic location and housing type*: Residents of climatically extreme regions who have low-quality, poorly insulated homes tend to have comparatively high environmental impacts. The situation is more complicated than a simple case of relatively warmer or cooler climates, however. One also needs to account for such issues as the vastly different policy circumstances that are created by housing stock that is predominantly owner occupied versus renter occupied as well as factors related to how different information technologies (feedback) and energy-control devices (e.g., thermostats) can differently affect household energy consumption without changes in price or other policy parameters (Kempton and Montgomery 1982; Wood and Newborough 2007; Burgess and Nye 2008).

Contributions of Insights of Studies in This Special Issue

Three of the articles that comprise this special issue contribute to the trajectory of research centered on the development and implementation of methodological tools to link consumption activities with environmental impacts.

The first article, by Bastien Girod and Peter de Haan (2010), analyzes the greenhouse gas emissions of households in Switzerland by income. Whereas most studies to date have applied a (monetary and top-down) EE-IOA approach, these authors develop a bottom-up, LCA-based model that expresses household consumption in physical functional units (e.g., kilograms of food, kilometers of travel, and square meters of living space). First, this article demonstrates that a bottom-up, physical model compares favorably with other analyses of CO_2 emissions per final consumption category in Switzerland. Second, the authors show that higher income households tend to buy (within a specific consumption category) products with relatively higher prices per functional unit—and, hence, lower impact per Euro expended. Classical monetary, top-down EE-IOA approaches are blind to this point because they assume price homogeneity and thus tend to overestimate the environmental impacts of marginal consumption. This assumption of price homogeneity neglects the potential for people to decouple income and environmental impact by consuming better instead of more. The policy implication with respect to sustainable consumption is that policy makers should aim at preventing goods of higher quality from having larger environmental impacts, to benefit from the increasing quality orientation associated with rising income.

Second, Jan Christoph Baiocchi, Giovanni Minx, and Klaus Hubacek (2010) use commercially available geodemographic consumer segmentation data to relate CO_2 emissions to different lifestyle groups in the United Kingdom. They argue that geodemographic data are particularly useful for this purpose, as they recognize the close relationship between people and places. In fact, knowledge about people's whereabouts reveals information about them and helps researchers understand their emission patterns. In their analysis, the authors link information from the ACORN database on the spending patterns of 17 household groups and 56 types across 34 final consumption categories into an environmental input–output model to estimate the direct and indirect CO_2 emissions associated with different lifestyles. This analysis shows that lifestyles are important in determining CO_2 emissions from consumption in the United Kingdom, where differences in consumer spending across lifestyle groups can lead to variations in per-household CO_2 emissions up to a factor of 3. In general, wealthier, rural households tend to have relatively high CO_2 emissions due to high expenditures on transportation. For less-affluent, urban households, housing tends to be responsible for a relatively large share of their total CO_2 emissions.

Baiocchi and colleagues (2010) present a further panel regression analysis to estimate the relationship between household CO_2 emissions and several socioeconomic factors provided in the ACORN database. The analysis shows that CO_2 emissions in absolute terms rise with income, more than proportionally for wealthier households. Also, larger homes, retirees, and single-occupant households tend to be associated with higher CO_2 emissions. If all else is constant, higher education (which is positively correlated with income and CO_2 emissions) tends to reduce emissions from consumption. In a final illustration, the authors demonstrate how to use the geodemographic information to understand spatial emission patterns and how this information might be applied to guide practical policies toward sustainable consumption.

The third article in this part of the special issue is by Manfred Lenzen and Greg Peters (2010) and represents an initial attempt to investigate the environmental impacts of households in geographic perspective. Using a multiregional input–output model and spatially explicit production data, the authors calculate the geographic dispersion of economic turnover, employment, water use, and greenhouse gas emissions for two typical urban households in Australia's two largest cities—Sydney and Melbourne—along its upstream supply chains and to numerous production sites across the country. The article includes maps that visually demonstrate how a

single household contributes to the environmental effects that are realized across an entire continent. This contribution constitutes an important step toward spatially explicit environmental input–output analysis, which is a precondition for addressing regional pollutants and localized impacts associated with resource extraction and consumption.

Changes Toward Sustainability

Introduction

Questions pertaining to how consumers can support changes toward more sustainable patterns of consumption and how they can be influenced to make more sustainable choices have been subjected to detailed consideration over the last couple of decades. We first discuss insights from the field of consumer studies and then review the articles in this special issue that speak to these matters.

Factors Supporting Consumer Behavioral Change

Understanding Consumer Choice

As Jackson (2005) observes, the complexity of consumer decision making leads to the following dilemma: One can either develop comprehensive analytical models that are too elaborate to provide clear advice, or one can apply models that are simpler but necessarily condense the richness and complexity of consumption into a handful of explanatory variables. Given this conundrum, it is perhaps not surprising that we find different schools of thought and that each has its own characteristic perspective on how consumers can contribute to sustainability.[6]

Despite this diversity of viewpoints, some basic insights are widely shared, most notably perhaps with respect to the dichotomy between *needs* and *wants*. Although neoclassical economics suggests that human desires are infinite, given, and stable over time, authors such as Max-Neef (1992) contend that there are finite, few, and classifiable (axiological) needs, the most prominent of which are subsistence, protection, affection, identity, creation, and freedom. Moreover, these requirements can be met by different "satisfiers," including ones with an outsized ecological footprint.[7]

Yet there is considerable ambiguity in the contemporary understanding of how consumers actually choose products or services in a diverse and abundant marketplace. One popular view follows theories based on the notions of planned behavior or reasoned action (Ajzen and Fishbein, 1980; Ajzen 1991). From this perspective, consumer decisions are made under volitional control, and intentions are a function of attitudes (beliefs) and subjective norms (social pressure). This view produces a picture of a rational, sovereign consumer who, through his or her ability to "vote" through the process of market selection, seeks to maximize his or her utility. This individual utility-maximizing behavior determines the success or failure of producers.

Other scholars emphasize that, in many cases, consumers are driven by material and social contexts that, in practice, allow for limited choice (see, e.g., Schor 2004; Schwartz 2004).[8] More pointed critiques assert that the whole idea of rational choice is a myth (Lindblom 1959; Simon 1997). According to this view, consumers have no alternative but to take heuristic shortcuts when making the hundreds of small, often mundane decisions that animate daily life. They discount the future, give preference to novel and extreme experiences, avoid situations that are apt to produce losses more keenly than opportunities that hold the promise of gains, and fear dramatic risks more than commonplace dangers (even when the probabilities of damage are equal; Kahneman and Tversky 1979; Kahneman et al. 1982; Tversky and Kahneman 1986; see the work of Holdsworth and Steedman [2004] for an analysis in the context of sustainable consumption). Semiconscious and routine decisions, such as choosing a pub, shop, or brand, are often only altered by disruptive events, crises, or other "windows of opportunity," such as moving to a new residence, getting married, or changing jobs. The path-breaking work of sociologist Anthony Giddens (1984) on structuration theory is a common point of departure for social scientists, who tend to see behavior as a coevolving mix of individual (semiconscious) agency and structure (e.g., Shove 2003; Spaargaren 1997; Røpke 2009).

This set of perspectives tends also to recognize that people purchase goods and services not only for their qualities and functions but also for their symbolic or identity value (Campbell 1987; Bauman 1990; Miller 1995; Baudrillard 1998). The pioneering anthropologist Mary Douglas (1976) saw consumer goods as means for consumers to first construct the social world and then to define their place in it. Such a view is corroborated by social survey evidence indicating that although people strive for financial security and to live in material comfort, their deepest aspirations are nonmaterial. Public opinion pollsters have long reported a desire on the part of consumers for a greater sense of lifestyle balance—to bring material gains into harmony with the nonmaterial rewards of life (Consumers International 1997). Material consumption is needed but in itself does not contribute significantly to personal happiness (or subjective well-being) beyond a relatively modest threshold (NEF 2006; Jackson 2009).

We must also consider the findings of social scientific research that indicate that consumption choices are based not only on individual choices but also on existing and available infrastructure and on established social norms. Even if consumers are willing to make sustainable choices, they often find themselves locked into unsustainable user practices and infrastructures (Sanne 2002). In this regard, studies that demonstrate how structural frameworks influence and shape consumer behavior are extremely important (Noorman and Uiterkamp 1998; Van Vliet et al 2005).

Change Models

The description above suggests the existence of various leverage points for modifying consumer behavior and engendering more sustainable lifestyles. A number of one-dimensional approaches have attracted increasing attention in recent years.

- Increase consumers' knowledge about products and processes with labeling and other information-oriented measures.
- Shift consumer attitudes through awareness campaigns.
- Alter the symbolic meanings of consumption by, for example, making sustainability values such as equity, human rights, and care for nature part of the values carried by certain consumer goods.[9]
- Change consumers' habits and routines.
- Create windows of opportunity for behavioral change by offering, for instance, alternative opportunities for fulfilling needs.

Experience suggests, however, that such approaches, when implemented in isolation, have marginal effects, particularly if the aim is to achieve comprehensive behavioral change (cf. Vlek et al 1999).[10] A careful balance of persuasive and dissuasive strategies is necessary to create enduring adjustments in lifestyle practices. Policy makers need to devote detailed attention to overcoming existing routines and to instituting sustainable alternatives in their place. Motivational strategies to create supportive social environments through role models, social learning, and participation and to foster a sense of community and impart credible, fair, and legitimate shared values tend to offer better prospects for success than, for instance, moralizing or appealing to individual altruism. Guidance must be direct and emotionally engaging, repetitive, and enforced by other factors, such as peer emulation (Holdsworth and Steedman 2004). But, most important, motivational techniques must go hand in hand with the creation of alternative behavioral opportunities for fulfilling needs that are comparable to preexisting alternatives in terms of both tangible and intangible quality.[11]

Scholars who endorse a social practices approach emphasize the interaction between motivation and context and hence choose a unit of analysis that is rather specific to a particular setting or application (Spaargaren 2003; Spaargaren et al. 2006; Guy and Shove 2007; McMeekin and Southerton 2007; Gram-Hanssen 2007, 2008; Kjellberg 2008; Quitzau and Røpke 2008; Wilhite 2008; Røpke 2009). For example, efforts to realign transportation preferences from this perspective should not concentrate on the physical dimensions of mobility but rather should focus on commuting, shopping, family visits, or beach holidays. A recent comparative study of sustainable consumer behavior in ten OECD countries

underscores the challenges of pursuing "easy alternatives" though the use of narrowly conceived interventions. The willingness to pay for more sustainable products is usually limited to a price differential of 5% to 10%, and factors such as direct access to public transport have a high impact on automobile ownership (OECD 2008).

Contributions of Insights of Studies in This Special Issue

Five articles in this special issue are devoted to exploring issues pertaining to the social dimensions of promoting changes in individual and social practices that could align consumer behavior with more sustainable patterns. The first contribution of this grouping, by Eva Heiskanen and Raimo Lovio (2010), discusses user—producer interactions in the promotion of household-energy innovations and focuses specifically on efforts to encourage effective communication among different actors. The authors evaluate the role of user representation in a project designed to encourage uptake of low-energy housing and highlight critical failures of communication that ideally should have been addressed at the project-design phase. The article suggests several ways to intensify knowledge exchange among the users and experts of low-energy housing as a way to stimulate novel innovations in the residential construction sector.

Second, Matthias Deutsch (2010) investigates whether the provision of life cycle cost (LCC) information to consumers induces them to choose more energy-efficient household appliances and considers the impact of LCC disclosure on retailers. An online field experiment for washing machines provides data on which the analysis is based. This article demonstrates a slight preference on the part of consumers for more energy- and water-efficient appliances, but this predisposition does not translate into an increase in retail volume. The author concludes that LCC disclosure may have some implications for environmental policy, and he offers several suggestions to improve the format for information disclosure.

Third, Josef Kaenzig and Rolf Wüstenhagen (2010) explore further the role of LCC provision and propose a conceptual model to assess the influence of such information on consumer-investment decisions for eco-innovation. The studies evaluated by the authors confirm the findings presented in the contribution by Deutsch (2010), namely that LCC information can have positive effects on the likelihood that consumers will purchase environmentally preferable equipment. Kaenzig and Wüstenhagen conclude their article by noting that instead of trying to find ways to encourage consumers to pay more for eco-innovation, promotional efforts should focus on reducing the perceived initial costs and increasing public awareness of LCCs. They also stress that LCC information provides an important base for long-term thinking not only for individuals but also for business managers and policy makers.

Fourth, the article by Michael Nye and Thomas Hargreaves (2010) focuses on the role of context in shaping the course and outcomes of interventions to stimulate environmentally significant behavior. They evaluate the social dynamics and mechanisms of two team-based initiatives designed to promote behavioral change at work (Environment Champions) and home (EcoTeams), placing their analysis against a background informed by sociological theories of symbolic interactionism. The analysis shows that these projects opened up different levels of opportunity for reviewing and renegotiating new behaviors in light of the expectations and reactions of immediate peer groups and existing workplace or domestic roles. The same observation applies with regard to situation-specific definitions of what counts as appropriate conduct in the home and workplace. Consistent with the work of social practice researchers, Nye and Hargreaves argue that more attention should be devoted to processes of behavior change and to the contextually sensitive relationship between interventions and outcomes. These are necessary steps toward refining and streamlining efforts aimed at changing environmentally significant behavior.

Finally, Kirsten Gram-Hanssen (2010) studies various strategies to encourage householders to reduce their use of standby electricity from a social practices theory perspective. Her approach is informed by a sociotechnical understanding of consumption that regards user practices to be amalgamations of technological capability and routinized behavior. The utilization of standby

electricity by household appliances such as televisions and video recorders represents a particularly challenging mode of consumer behavior because it is an invisible and particularly ephemeral form of energy consumption. The article reports on findings from a series of interviews that Gram-Hanssen conducted with Danish householders to assess their electricity usage over the course of a year-long experiment involving exposure to different communicative and technical interventions. This work exposes the weaknesses in widespread presumptions of consumer rationality and highlights instead the pragmatism that consumers exhibit in negotiating the obstacles of everyday life.

Conclusion

This special issue discusses the role of SCP in industrial ecology from two perspectives. The first angle is consistent with the customary approach that industrial ecologists have generally taken over the past decade, namely trying to develop new insights into the relationship between (the determinants of) extant household consumption and its environmental impacts. The second standpoint is commonly taken to be less germane to the field of industrial ecology and focuses on trying to understand which interventions are likely to be most effective in fostering behavioral changes toward more sustainable patterns of consumption and production.

The foregoing discussion suggests that the more analytical questions pertaining to how household consumption translates into environmental impacts are currently attaining a level of maturity. Dozens, if not hundreds, of studies have been carried out in recent years to assess these relationships either through EE-IOA or LCA-based approaches, and the main policy-relevant conclusions are, by this point, fairly clear. The areas of food and beverages, mobility, housing, and energy-using products constitute the key priorities. Income, home dimensions, household size, and so forth are the key variables that explain the relative impacts of consumption per capita. It is obviously possible to further refine such analyses in the future—for instance, by switching from monetary-based EE-IOA models to models that are organized around physical metrics (Girod and de Haan 2010), improving the regression analysis of underlying factors that explain the relationship between consumer behavior and impacts (Baiocchi et al. 2010), and improving the assessment of burden shifting between regions and countries (Lenzen and Peters 2010). It would furthermore be useful to develop standardized data sets so that change can be more readily monitored across time, geographic areas, and consumer groups. Although we admit that these issues are important, they entail fine tuning within existing analytic frameworks in which the main problems and answers have already been determined to a large extent.

We currently face a very different situation regarding which interventions are likely to be most effective in massively reducing the environmental impacts of household consumption. The articles in this special issue highlight some interesting approaches, such as the effects of improved user—producer interactions (Heiskanen and Lovio 2010), the impact of LCC disclosure on consumers (Deutsch 2010; Kaenzig and Wüstenhagen 2010), and the importance of higher sensitivity to both context and the symbolic meanings (Gram-Hanssen 2010; Nye and Hargreaves 2010). Our dearth of knowledge on such issues poses significant challenges, and it is apparent that the articles in this special issue provide only partial answers with respect to how a transition to more sustainable consumption and production might be realized.

For industrial ecologists, this situation poses a set of important and stark questions. Do we want to be a community that excels just in analyzing the drivers and impacts of *current* consumption and production patterns? Or do we want to widen our view to embrace a more expansive perspective that seeks to understand *changes* toward sustainability through such approaches as complex system theory and theories of sociotechnical evolution? For us, the answer is unambiguous. Even though the latter way forward will entail research that is more politically fraught, it will impel industrial ecologists to seek proactive solutions to problems rather than to just passively analyze them. Such a strategy can only enhance the impact of our research, particularly if it is undertaken with the highest regard for scientific integrity, as rightly characterizes the field.

Notes

1. A great deal of evidence shows how policy interventions in fertility, transportation, housing, and many other areas contribute to changes in household consumption. A recent example pertains to the "cash for clunkers" programs instituted in Japan, Germany, the United States, and the United Kingdom to stimulate automobile sales by encouraging households to replace older vehicles with new models. Although these initiatives seem to have had their intended economic effects, they have had the inadvertent consequence of increasing life cycle emissions (Kagawa et al. 2009).
2. This approach of relating environmental impacts to household consumption has resonance with strategies other authors have taken to subdivide Ehrlich and Holdren's famous equation ($I = PAT$) into more detailed constituent factors. See, for example, the work by Chertow (2001), Tukker and Tischner (2006), and Spangenberg and Schmidt-Bleek (in press).
3. Exceptions include articles by authors such as Tim Jackson (2005) and Juliet Schor (2005) in the special issue of the *Journal of Industrial Ecology* on sustainable consumption, edited by Edgar Hertwich (Volume 9, Issues 1–2, January 2005).
4. See Volume 9, Number 1–2, and Volume 10, Number 3, respectively, for these special issues.
5. This characterization does not hold, of course, if there are significant differences in the incomes and lifestyles of urban and rural populations, as is frequently the case in industrializing countries (Hubacek and Sun 2001, 2005) and Tukker et al. (2006b) in Volume 10, Issues 1–2, 2006.
6. We focus here on changes in consumer behavior in the conventional sense and refrain from discussing what in some contexts is referred to as *political consumerism*. This term is generally used to refer to consumers who purposefully act in their capacity as citizens to effect changes in political and economic spheres. As Micheletti (2003) describes, consumers can contribute to efforts to shape societal norms and values and can potentially become powerful agents in bottom-up actions for change. A separate but related area of inquiry is emerging within the field of marketing research and focuses on the notion of consumer resistance, or anticonsumption (Lee et al 2009). Other authors emphasize the importance of businesses, civil society organizations, and community groups that are seeking to inspire grassroots movements for sustainable consumption (Michaelis 2003a; Cohen 2005; O'Rourke 2005; Middlemiss 2008; Seyfang 2009). These activities seem to be particularly important at present with respect to food.
7. Indeed, some satisfiers are just perverse "destroyers" and do not fulfill any axiological need. For instance, drugs and alcohol may provide temporary relief from depression but do nothing to change the fundamental shortcomings in one's personal lifestyle and eventually create problems of their own (cf. Ehrenfeld 2009).
8. Most household expenditures are devoted to relatively mundane forms of "ordinary consumption," such as mortgage payments, taxes, pension contributions, utility bills, health insurance, school fees, and commuting expenses. Other consumption norms include people's expectation of a clean shirt and a shower each day as well as a vast number of commonplace products delivered by global production systems.
9. This point implies articulation of alternative values through the activities of governments, consumer groups, and NGOs. Antismoking campaigns and public initiatives to reduce drunk driving are prominent examples of such strategies. Similarly, the efforts of prominent figures such as Al Gore (2006) and Nicholas Stern (2007) have entailed effective use of the media to change opinions about the urgency to act on climate change. The United Nations also took a major step in this direction when it launched the Millennium Goals and the Global Compact. The Millennium Goals set targets for the most critical contemporary social and environmental global problems and have been unanimously endorsed by member states. The Global Compact invites companies to endorse key social and environmental principles, and 5,000 business firms have thus far signed the accord. These actions have arguably moved the discussion about which sustainability goals to pursue (or, indeed, whether it is useful to pursue them at all) forward to the question of how these goals can be most effectively achieved. See www.unglobalcompact.org and www.un.org/millenniumgoals.
10. When consumers face very simple choices that do not entail behavioral shifts, basic price incentives and awareness campaigns can indeed be effective. The change from leaded to unleaded gasoline in Europe during the early 1990s highlights this kind of adjustment at work (Holdsworth and Steedman 2004).
11. The motivational and educational element of consumption can be described as "software," and the creation of new behavioral opportunities in the

form of products, services, and infrastructures with lower environmental impacts can be thought of as adjustments in the "hardware." For example, efforts to encourage consumers to reduce their automobile dependency without providing high-quality and convenient alternatives in the form of public transportation, delivery services, car sharing, vehicle-rental opportunities, and bicycle paths will not yield the desired result. The new societal hardware and software should encourage, enable, engage, and exemplify more sustainable ways of living and facilitate shifts toward more sustainable lifestyles. Only under such circumstances will a sufficiently large number of people embrace ownership of a better and more sustainable world (see, e.g., Mont 2007).

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