SOCIAL BEHAVIOR: LIMITING GLOBAL CHANGE OR LIMITS FOR MITIGATION?

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1. INTRODUCTION

Traditional concerns about the physical and economic availability of adequate energy resources have given way to increasing awareness of global and long-term environmental impacts of energy production, conversion and end-use. Thus, perceptions about factors ultimately limiting future energy growth have changed, while the driving forces are still the same: population and economic growth. Although population growth in developing countries is frequently argued to represent the most difficult problem for the sustainability of the global commons, it is necessary to recall the quantitative picture from both a current and a historical perspective. Developed countries account currently for 72 percent of fossil energy related CO_2 emissions, and for 84 percent of the accumulation of fossil-fuel CO_2 in the atmosphere since the onset of the Industrial Revolution. Even if taking deforestation and land-use changes into account, the problem, especially in terms of historical responsability remains one of the northern hemisphere: Developed countries account for 63 percent of current and for 78 percent of cumulative CO_2 emissions from all sources taken together (Grübler and Fujii, 1991).

The reason for such a significant North-South divide is obvious: there is a factor ten difference in the average per capita energy consumption between developed (7 KWyr/capita) and the developing countries (0.7 KWyr/capita). Thus although population increases projected for developed countries are quite small (according to the UN high scenario some 200 million people over the next 30 years), their high per capita consumption levels could contribute a similar order of magnitude to emission increases than all the population growth in the developing countries (of some 3250 million people over the same time horizon), as illustrated in Figure 1.

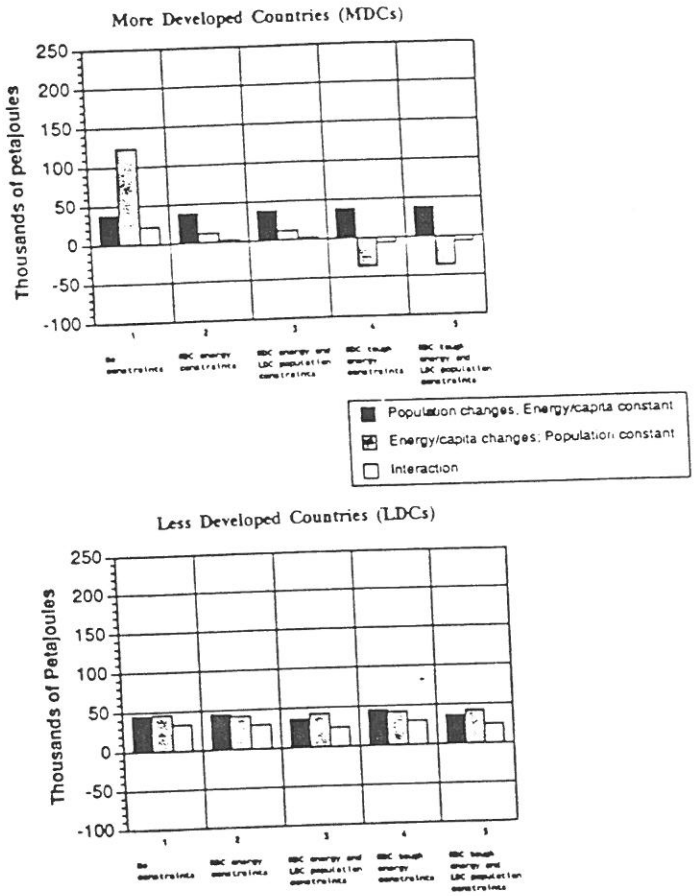

Figure 1. Components of change in commercial energy consumption scenarios up to the year 2020. MDCs versus LDCs. Although population growth in MDCs over the next 30 years will be extremely small compared to the projections for LDCs, their current high per capita energy consumption levels imply that energy consumption growth from population increases may be of a similar order of magnitude in both hemispheres. The high per capita energy consumption in MDCs is to a large extent result of particular consumption patterns that have evolved with increasing levels of affluence. Social value and behavioral changes are consequently frequently advocated as response strategy to global change. Source: Kolsrud, 1991.

Thus, if one discusses measures and strategies to limit and ultimately to reduce GHG and in particular CO_2 emissions we have to concentrate first of all on developed countries based both on equity as simple pragmatic considerations. This because of the 1) dominance in historical responsibility and current contribution to emissions of developed countries, 2) their high levels of affluence (and thus ability to effectively invest in countermeasures), and 3) their high per capita emission levels, which -if lowered- could yield the highest overall emission reduction at a global level.

In industrialized countries today about two thirds of final energy demand are consumed outside the productive sphere (agriculture, industry and manufacturing) proper. Furthermore, energy use for private households, transportation and leisure activities is steadily increasing, illustrating a progressive shift from a producer to a consumer society also in energy and environmental terms. At the same time, it is precisely these end-use applications, where energy efficiency, especially in the conversion of final and useful energy to the ultimate services rendered to the consumers continues to be extremely low (Figure 2), indicating a large theoretical potential for lowering energy consumption and thus emission levels, whilst maintaining or even increasing the actual services rendered (Nakicenovic et al., 1990).

Whereas traditional energy models and policy instruments focusing on availability, quality and relative prices of competing energy carriers are useful in capturing the evolving patterns of energy use in the productive sector, for instance towards higher energy efficiency per unit of value added, new approaches are needed to analyze energy consumption patterns outside the industrial sector proper. This, because energy demand in these applications appears much less determined by traditional influencing variables and policy measures in the final energy market (like energy prices), but is instead by (changing) social values and preferences, and behavioral and lifestyle variables. It is also these "soft" variables, which increasingly influence the efficiency by which energy is converted to the services required. For instance, whereas fuel efficiency of passenger cars have increased noticeably over the last two decades, these technological efficiency gains have been largely offset by increases in service demand (more km traveled by car), and lower usage efficiency (less passenger-km per vehicle-km driven).

The influencing variables of energy demand for private consumption show a wide dispersion between different countries, cultures, social strata, and between generations. Furthermore, from both theoretical and empirical perspectives, relatively little is agreed about the nature of social behavior in relationship to energy demand, and possibilities and potential for

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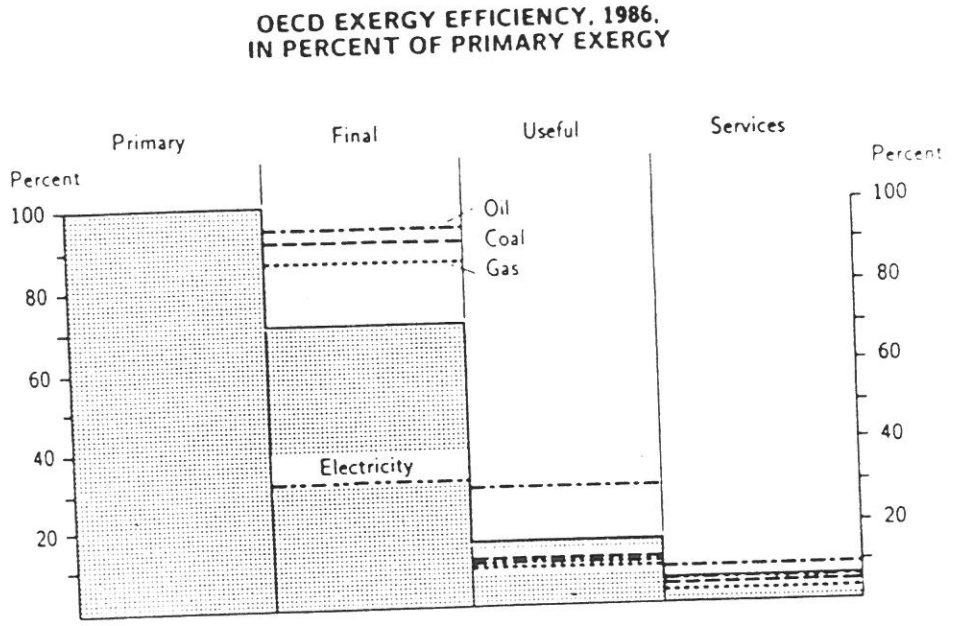

Figure 2. Exergy balances for the OECD countries in 1986 (in percent of primary exergy). A second-law analysis of the exergetic efficiency of the exergy (and energy) system in the OECD countries, shows that while the efficiency in the provision of final exergy is already quite high, efficiencies at the end-use side, and in particular in the provision of services are low. The overall exergetic efficiency of the OECD countries is estimated to among only to a few percent. Figures for the USSR and developing countries are probably event lower. This indicates the large theoretical potential for efficiency improvements of between a factor 20 to 100. Realization of this potential depends however on a detailed understanding of the reasons of low energy end-use efficiencies which are not always related to technology but to the way technologies are used by consumers for delivery of the final services demanded. Source: Nakicenovic et al., 1990.

changes from the perspective of GHG mitigation strategies. Social behavior is an important part of the connective tissue linking individual, micro-economic decisions with observed, macro-economic phenomena, yet social and behavioral phenomena are peripheral to most treatments of energy consumption in energy models. In this respect our analytic tools should generate a theory of energy consumption based upon a proper theory of human behavior, and not the other way around. What do people do, and why do they do it? Answers to these questions must form the basis for a comprehensive understanding of patterns of energy use. In short, we argue that we lack not only widely accepted theories of consumption and consumer preference formation, but also good theories to explain *differences* in consumption patterns in time and space and between different social groups and how they relate to levels and efficiency of energy consumption which determine environmental impacts.

Particular consumption and spatio-temporal activity patterns of people are usually referred to as lifestyles. However, lifestyles do not evolve autonomously nor can they be separated from the social, economic and even natural environment in which people live. The socio-economic environment does not only contribute to values and preferences formation leading to differentiated ways of life, but also serves as an "enabling" setting for personal consumption in terms of income, and products and services available (or unavailable) to the population or particular social groups. Finally the natural environment provides (hithero usually externalized) dissipative "services" of the effluents created by the metabolism of both production and consumption. In addition, the state of the environment feeds back not only on the quality characteristics of lifestyles, but also to their evolution as a result of perceptional and values changes of people. Thus, the social evaluation of different artifacts and behaviors is bound to evolve over time, reflecting the changing "standard of living" or "lifestyle" of given groups at given times in their history. Understanding scientifically this dynamic perspective of social behavior appears as a prerequisite before entering any discussion on the possibility, desirability, and incentives to behavioral changes under the wake of global change.

A workshop on "Social Behavior, Lifestyles and Energy Use" was organized a few months ago at IIASA to examine this set of problems from an interdisciplinary perspective. Scientists from a range of engineering and social science backgrounds gathered to examine the question of lifestyles: How can we characterize different lifestyles with respect to energy intensity? Where can we look to find the sources of these variations? And what are the implications of these findings for the future? The general analytic approach adopted by the workshop

participants was focused on establishing and exploring the interconnections among the various disciplines there represented. Below we will discuss three analytical and empirical perspectives which were (among others) presented at the workshop, including cultural theory, time budget research and demographic analysis. They address the problematique from different conceptual and empirical, as well as disciplinary perspectives and as such illustrate perhaps best the current status of social science research in this area and the long way we still have to go before being able to develop policy recommendations based on a through theoretical understanding of our social system instead of normative or ideological positions.

2. THREE PERSPECTIVES OF SOCIAL BEHAVIOR AND CONSUMPTION INTERACTIONS

2.1 Anthropological and Cultural Analysis

Culture (or more precisely, cultural difference) plays an important role in shaping lifestyles and, in turn, energy-use. Desires, beliefs, norms, and expectations all structure and channel our behavior. Such arguments are hardly unique to energy; culture is said to influence everything from the work ethic to the suicide rate. Granted that culture is important, a major question concerns how to sift out its impact. One cognitive approach presented at the workshop examined the linkage between public perception and behavioral response for a number of different environmental threats (Kempton, 1991). The idea is to imagine "culture" as part of the system through which human actions are generated by outside stimuli. Culture predisposes or encourages us to respond to given stimuli in specific ways, but is not in and of itself the agent of causation. Thus, the theory suggests the following: in cases where the linkage between perceived environmental threat and behavioral remediation is clear and where the proposed behavioral modification is relatively painless, behavioral response is rapid and robust (i.e., there is positive feedback between culture and behavioral change). But when the behavior in question is intrinsic to the socio-economic system (e.g., waste generation in modern "disposable", consumer societies), then culture becomes an impediment to change. From this perspective, inherently unsustainable lifestyle patterns cannot be modified *ex nihilo*, but instead require radical changes in the cultural context.

An alternative approach, based upon the formulation of cultural theory as for instance formulated by Mary Douglas, proposes an elevated role for cultural difference. The question it asks is: Why do different people want different things, and why do they want the things

they want? In other words, where do preferences come from? Cultural theorists (e.g. Thompson, 1991) argue that almost all social science (economics, in particular) takes preferences as given. Usually, the assumption is that preferences are intrinsic: something that people are born with like their finger prints. A variant of this is that there is a hierarchy of needs and that people move on to the higher once the lower ones are secured. A corollary of this hypothesis is that ultimately lifestyles are seen converging with increasing levels of affluence. From such a perspective, energy consumption would necessarily increase significantly in the future.

Cultural theory suggest an alternative way to develop a proper theory of consumption (or preferences formation). The theory proposes that *people discover their preferences in the process of establishing their social relations*. Preferences, therefore, come in patterns, and those patterns are strictly limited to the number of patterns of social relationships that are possible. We all know about two of these patterns - *markets* and *hierarchies* - and cultural theory goes on to show that there are two more: *egalitarian bounded groups* and *excluded margins* (Figure 3). Cultural theory thus argues that social relations define a small number of distinctive social groups, each of which with an identifyable particular set of preferences, "way of life", even a particular "worldview". Each group can consequently be associated with fundamental attitudes towards the natural world - so called "myths of nature" (Figure 3) - and then linked to difference of thought and action. That is to say, cultural types - *hierarchists, egalitarians, individualists,* and *fatalists* - transcend spatial and temporal boundaries. Work in progress is attempting to connect these putative cultural types with their respective lifestyles and associated energy profiles. However, at present the empirical corroboration of cultural theory remains at best fragmented. Statistical evidence would suggest that a grouping along a limited number of "archetypes" as formulated by cultural theory is indeed possible. However for the time being there are few quantitative indications of the links between the "ways of thinking" and the "ways of acting" of the cultural archetypes postulated. There is also the argument that to posit the existence of a few immutable cultural "types" is both ethnocentric and deterministic.

Thus, as appealing as cultural theory is (and we might add *any* cultural theory), we are still left wondering how it helps us to comprehend, analyze, and predict future pathways of social behavior and lifestyle choice and how it could relate to changes in energy demand patterns and environmental impacts at large. For the present the theory seems more appropriate as a heuristic for understanding systems of belief (i.e., perphaps to analyze voting patterns and

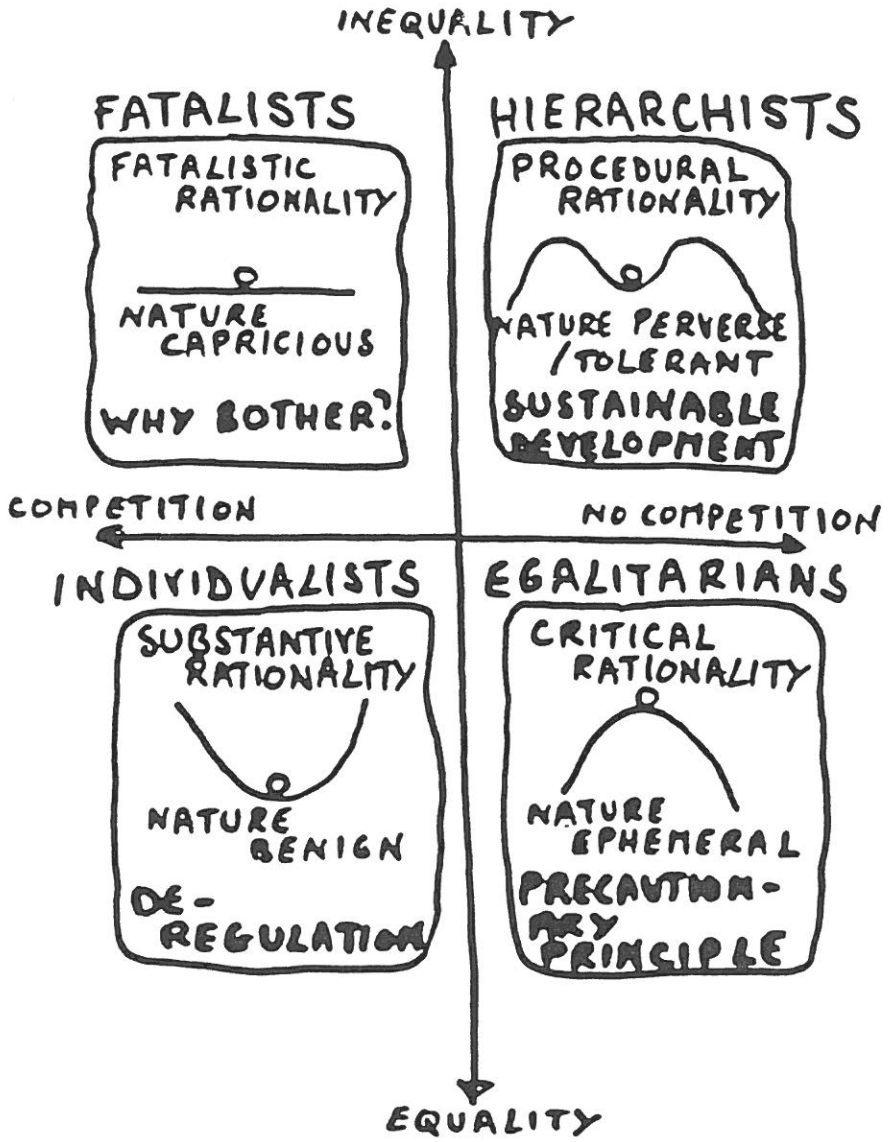

Figure 3. A typology of human preference formation as proposed by cultural theory. People are defined along two dimensions of their social relationship formation: hierarchies (inequality-equality relations) and markets (competitive-non-competitive relations). Each group is then associated with a particular "world view" as reflected in their "myths of nature". These can then be related to the preparedness of changes in consumer preferences and habits in order to mitigate adverse environmental impacts. Source: Thompson, 1991.

other public policy problems) rather than for understanding systems of social behavior.

2.2 Time budget research

On the other extreme there are approaches and theories that take a different analytical route. Instead of formulating first a theory of preference and value formation, and then to worry about how these are translated into differences in consumption and behavioral patterns, empirical research into actual activity patterns tries to derive a typology of social behavior form various combinations of human activities, as reflected in the time allocation of different people. Time budget research assumes that human behavior comes first; perceptions and beliefs are reproduced in the daily time accounts as reported in detailed diaries.

The secular trends identified - for instance that "the richer you are, the less paid hours you work" (Gershuny, 1991) - seem to embody common sense across a wide range of cultures and countries. Also certain convergence tendencies of activities away from formal work, to other socially obligatory activities (like child care) and leisure proper at the international level and between genders (Figure 4) are noticeable empirical findings.

Time, moreover, is a convenient way to compare the valutation which people in different settings attach to various activities. As an example, time budget studies in developing countries show that people start attaching value to time only after they are allowed to join the formal economy. Indian women will spend uncounted hours gathering firewood only until they are allowed to put their time to more valuable use in the paid economy, at which point they use income to purchase (more efficient) commercial fuel. The use of time-budgets appears to emerge as an important tool in the study of social behavior. International and intertemporal time-budget series facilitate understanding of the linkages between broad categories of social activity and associated energy use. The reported cross-cultural data on the increase of leisure time relative to paid work (for men) and to unpaid work (for women) confirm the trend towards increasing leisure time, even as women continue to enter the workforce. Whether such changes lead to further increases in energy use can then be inferred from the types of leisure activities selected (i.e., energy intensive activities involving travel versus "sustainable" activities like gardening). It is also possible to combine existing data sets in innovative ways. For instance, Bartlett (1991) reported on successful analysis of the energy use of "pseudo"- couples (i.e., the cumulative consumption pattern of two single adults from similar socio-economic background - relative to that of a young married couple, thereby illustrating - without requiring the collection of costly, new data - the ways in which

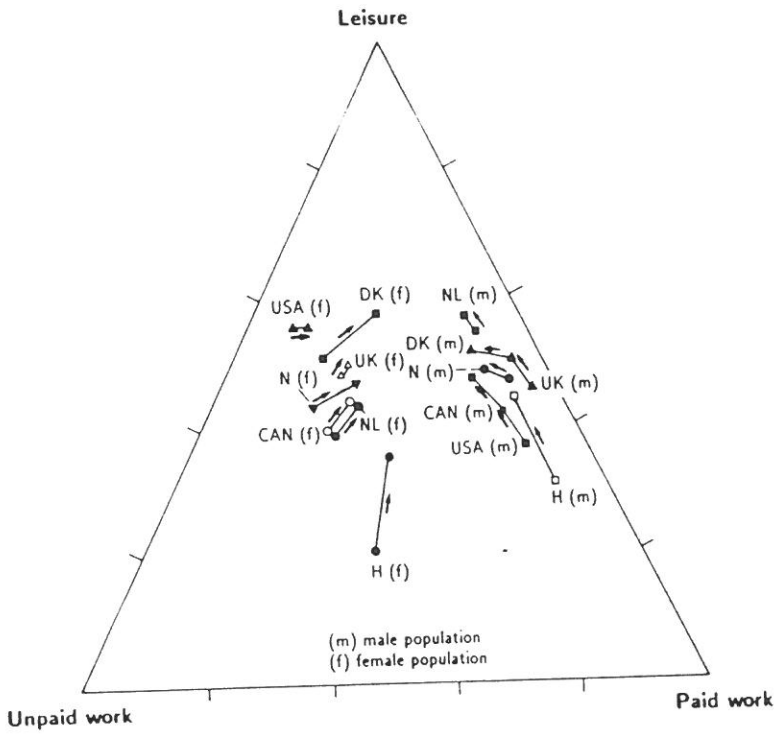

Figure 4. Relative allocation of time budgets to different activities, male and female population of seven countries. Note in particular the international and gender convergence away from formal, contracted work to unpaid work (e.g. family care) and leisure activities. Source: Gershuny, 1991.

lifestyle contributes to differential energy consumption.

Perhaps the most important lesson provided by time budget research is to acknowledge the complexity of criteria underlying consumer choices and preferences. Efficient use of capital and energy are important, but if indeed time is the ultimate scarce resource for consumers, policies to reorient technological solutions and consumer preferences in particularly energy intensive activities such as transportation (Figure 5) will have to go well beyond traditional intervention instruments, such as changes in the relative price structure of transport modes.

2.3 Demographic analysis

In addition to time budget surveys and other consumer survey techniques also demographic techniques may become important for future investigations linking lifestyle and energy use. In the first instance, demographers are concerned with the most important lifestyle issue of all: reproductive behavior. In the introduction we have mentioned that population growth in the developed world (where per capita energy consumption is relatively high) may poses a much more serious challenge to reducing global energy use than does population growth in the developing world. From the perspective of income and welfare, controlling population growth in the developing countries is still crucial, but from the energy perspective it is continued population growth in the affluent North which may equally threaten to overwhelm global conservation efforts.

At lower levels of aggregation, demographic perspectives offer interesting perspectives on social behavior from a generational perspective. A basic question in the analysis of possible changes in lifestyle patterns is to get a handle on direction and rates of value changes. Ronald Inglehart (1984) has analyzed longitudinal data of an indicator of materialism in the Japanese society (Figure 6). His analysis reveals clearly that the "decline in materialism" observed is first of all the result of an intergenerational population replacement. In 1953, 60 percent of the age group between 20 and 24 agreed that "money is the important thing" to teach a child, whereas the percentage of agreement in the same age group dropped to 18 percent 25 years later. Whereas agreement to this particular educational priority for children is somewhat dropped also within particular age cohorts, changes are small in comparison with the intergenerational value changes.

Somewhat ironically, this decline of "materialism" was accompanied by an unprecedented growth in material welfare in terms of the diffusion of automobiles, consumer durables and personal consumption. But this example of cohort dynamics as major driving force of social

USA – TIME AND ENERGY CONSUMPTION

	Time* 10^9 hrs	Final Energy 10^9 kgoe	Density kgoe/hr
At Home*	835.5*	236.6	0.28
At Work	291.1	660.0†	2.27
Services	183.5	152.0	0.83
Travel‡	107.6	279.0‡	2.59
Total	1417.7	1328.4	0.94

	10^9 kg C	kg C/hr
Carbon Emissions	1201.6	0.85

* Excluding sleep

† Including industry transportation, industrial energy use, agriculture, feedstocks

‡ Only passenger travel

Figure 5. Energy and carbon intensiveness of different activities for the US population. Excluding physiological time (i.e. time required for eating and sleeping) each US citizen consumes on average about one kg of oil equivalent energy per hour and emits roughly the same amount of carbon. Average energy related carbon emissions per capita per year in the US is in excess of 5000 kg per capita. The carbon intensiveness per unit time of transportation is particularly high. An average car emits approximately its own weight in carbon every year.

	1953	1958	1963	1968	1973	1978	Change Within Given Cohort, 1953-1978	
	%		%	%	%	%		
Age Group:								
20–24	60	–	43	34	22	18		
25–29	66	–	55	49	36	26		
30–34	63	–	58	58	42	37		
35–39	62	–	56	59	43	43		
40–44	65	–	63	59	46	49		
45–49	66	–	62	62	46	56	→ – 4	mean: –6
50–54	72	–	68	65	49	51	→ –15	
55–59	72	–	72	67	60	56	→ – 7	
60–64	77	–	76	66	59	62	→ 0	
65–69	78	–	72	73	59	62	→ – 3	
Spread between youngest and oldest:	+18	–	+29	+39	+37	+44		

Figure 6. Value change as a generational phenomenon. Cohort analysis of percent of Japanese public agreeing that "money is the most important thing" to teach a child. Source: Inglehart, 1984.

value changes holds important implications for the analysis of lifestyle patterns. We might argue that as young people become independent from their parents, they choose a particular way of life: in acquiring a given "package" of artifacts (housing, most likely a car, a telephone, a refrigerator, a stereo equipment, etc.) and in organizing their life in a particular social and spatial-temporal context (e.g., where they reside and work and how they commute in between, how much time they devote to different activities, e.g., caring for a child or working in an office, etc.). At a later age, lifestyles are to a large extend "locked-in" in particular material, social and spatial organizational settings, which prove difficult (and costly) to change. Thus, from a demographic perspective one could conceptualize that maturing generations adopt lifestyles and material expectations according to accepted norms at the time of "establishment", that is, when young adults establish independent homes. These norms then tend to remain relatively stable over time.

Patterns of automobile ownership in Western Germany confirm this phenomenon (Figure 7); and modeling work done at IIASA (Büttner and Grübler, 1991) indicate dramatic energy implications of future changes in patterns of artifact adoption coupled with various demographic scenarios ranging from "extreme graying" to "demographic revival". From this perspective, the degrees of freedom of lifestyle changes might indeed be largest in this early phase where a large number of critical decisions are made. Conversely, the degrees of freedom of changes in such "path dependent" lifestyles at a later age will be much smaller. This implies that the rates of lifestyle changes should be quite slow, but at the same time very heterogeneous, if indeed primarily based on intergenerational replacement dynamics.

3. WARM FEET WITH COOL HEADS

Each of above discussed analytical and empirical perspectives underline some general lessons. Multiple disciplines tend to generate multiple conceptual and analytical realities. Yet, even a truly interdisciplinary (or nondisciplinary) theoretical synthesis might not be sufficient if it is unable to explain important *rates of change*. That is, an ultimate linkage between demography, economics, anthropology, engineering and many other disciplines must be theoretically consistent, empirically verifiable, and inherently dynamic. A general, working definition of lifestyle is important, but understanding how lifestyle change over time is even more so.

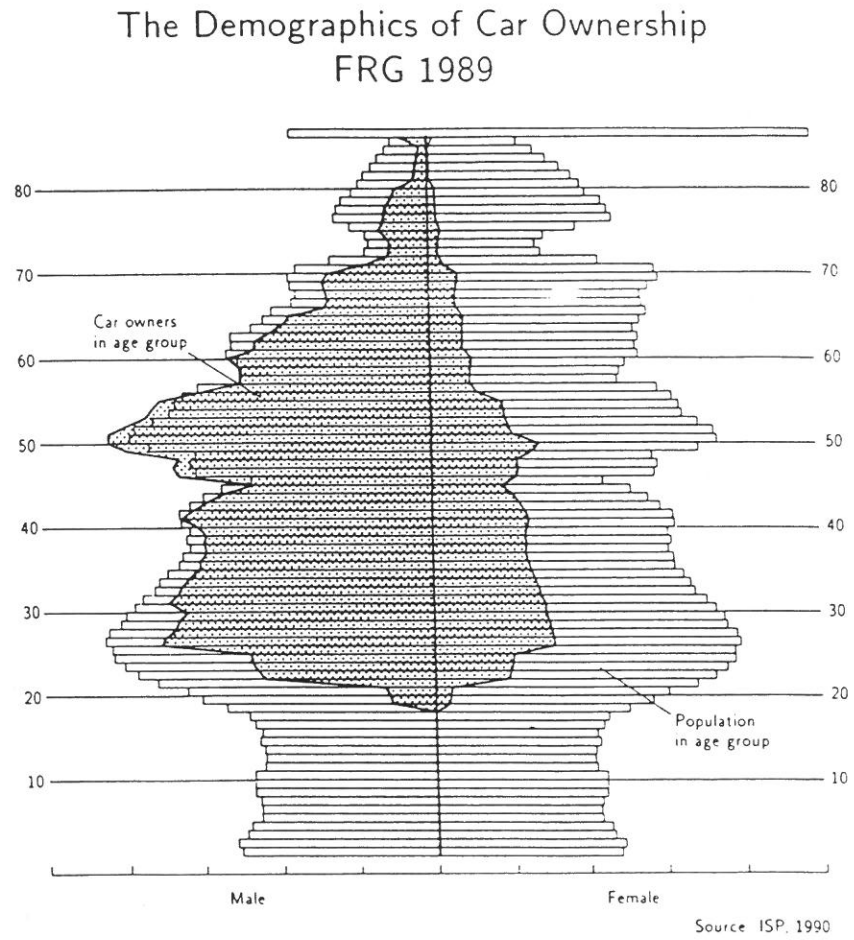

Figure 7. Demographics of car ownership in Germany (only former FRG territory) in 1989 revealing significant intergenerational and gender differencies in car ownership. Combined with demographic projections scenarios of future car ownership are developed at IIASA based on different scenarios of lifestyle changes of successive cohorts entering driving age. Conversely the ownership (or non-ownership) patterns of older generations are assumed to remain relatively stable, consistent with historical experience. Source: Büttner and Grübler, 1991.

At this point it may be useful to leave the somewhat abstract space of theories of consumer behavior and modeling of demographics, lifestyles and energy interactions with a small parabola. Yamaji (1991) describes the post-war transformation of the Japanese energy system. Although Japan has undergone a rapid shift towards the U.S. (i.e., high consumption) model of energy use, after accounting for structural and geographic differences, Japan is still more energy efficient than its major, industrial partners. Japanese society has long been forced to be more energy efficient than many Western countries because of Japan's perennial shortage of natural resources, resulting in specifically Japanese ways of life. As an example, Yamaji cites the "kotatsu" - a combined dining table and heating unit - which was traditionally used to heat Japanese residences. After dinner on cold nights, the family would remain seated around the "kotatsu" to keep warm, thus giving rise to the saying, "warm feet and cool heads".

The prosperity of post-war Japan has led to several related changes. First is the income effect associated with increasing wealth. The number of "kotatsu" in use in Japan now exceeds the number of households. Clearly, the social context of the artifact has also changed. Perhaps the old "kotatsu" is moved to a secondary location (like a second refrigerator in the West), or perhaps the "kotatsu" is retained as a traditional decoration in new homes equipped with central heating and air conditioning. In either case energy consumption rises even if the actual new appliances themselves are more efficient than the units they replace.

But perhaps even more important is the changing social context in which energy use takes place. The traditional (i.e., efficient) system of home heating depended upon the entire family spending the evening together. As Japanese society gradually changes, all kinds of behavioral patterns - from long commutes to increasing independence for the younger generation - have made the "kotatsu" - based system untenable because the social context for the provision of energy services has changed even as measured against unchanging basic needs. The Japanese people still want "warm feet and cool heads", but the "kotatsu" is simply no longer able to provide it.

4. CONCLUSION

After outlining a number of conceptual, modeling, as well as empirical inroads to the analysis of the complex interlinkages between social behavior and energy use many open policy questions remain. Can we direct the impact of culture upon social behavior? Can we be

confident enough in our knowledge of the global ecosystem to say what we *should* be doing? If the analytical perspectives discussed above have one thing in common, than it is the realization of the difficulty to affect human behavior in direction of lowering energy service demands. The persistent trends in direction of higher levels of affluence, increased leisure and ever higher levels of mobility have all led to substantial increases in energy services demand. That the actual primary energy demand in industrialized countries has not increased significantly over the last two decades is only due to technology stimulated efficiency improvements in the energy sector and economic restructuring in industry.

The key question remains how to affect the lifestyle and behavioral dimensions of energy demand in the North, eventually causing a trend reversal, and whether alternative development trajectories will emerge in developing countries assuring high levels of personal well-being with low energy consumption. In the future, as in the past, traditions, institutions, norms, and beliefs will constitute the framework within which specific lifestyles and habits will evolve. These need not necessarily be inconsistent with long-term environmental sustainability, but neither can they be expected to change rapidly enough to lead to a substantial decrease of energy services.

Therefore the fundamental problem facing most studies on energy and environment interactions is the discrepancy between the large theoretical potential for conservation and the lack of implementation by private consumers. The various social science perspective discussed in the paper illustrate that lifestyles and social behavior are associated with a high degree of inertia. Even worse, the studies indicate large conceptual and empirical gaps in our knowledge and understanding of social processes. However, energy conservation and less energy and resource intensive lifestyles are of paramount importance as one of the most effective measures in decreasing adverse environmental impacts of energy use. This is more so important because technological "fixes" such as efficiency improvements and economic sturctural changes are likely not to be sufficient to encounter the risk of global warming.

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