Will efficient technologies save the world? A call for new thinking on the ways that end-use technologies affect energy using practices

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Abstract
The subject of efficient technologies and how to get them into the homes and hands of users has been at the centre of energy efficiency policy from its inception. What the record shows is that efficient technologies may increase the efficiency of energy throughput, but that promised reductions in energy demand seldom pan out. Confronted with this problem, the usual policy approach has been to work harder to get markets, incentives, information to loosen up the 'barriers' to technology penetration. Social scientists have been recruited to facilitate markets with better information and incentives, in other words to improve 'behaviour'. The paper will argue that both technologists and behaviouralists have oversimplified the ways that technology scripts and socio-cultural contexts interact to affect energy-using practices. This paper will argue for a view new technologies are themselves change agents; their introduction into homes may increase technical efficiency but at the same time create potentials for new energy intensive practices. The concept of distributed agency will be introduced to capture the theoretical link between technology and behaviour. The examples of air conditioning and food refrigeration are used to illustrate these new ways of thinking. The potential for rethinking longer term policy to promote sustainable energy consumption will be explored.

Introduction

Energy efficiency policy of the past 30 years, both in OECD countries and in their energy development programs, has been grounded in the assumption that increasing technology efficiency is the way out of energy and climate crises. Implicit to this approach is a form for technology optimism or progressivism: deep reductions in energy use will be achieved as new and more efficient technologies march into homes in the North, and leapfrog by way of development programs and globalising markets into homes in the South. However, decades of policies grounded in this view of technology and its effects on practice have not for the most part delivered the efficiency gains (and equivalent energy reductions) that they promised (OECD 2004). If there has been any reaction to this failure in energy efficiency policy, it has been to argue that the problem is 'market barriers' to technology diffusion, and the strategy has been to find ways to bowl them over. Social scientists have been invited to figure out why people do not purchase new technologies when it is in their best economic interest to do so, or do not use them as they were intended. I will argue in this paper that both technologists and behaviouralists oversimplify the ways that new technologies affect practices and that it is the theoretical no-mans land between technology and behaviour which offers the most promise for future research and policy. I will introduce the concept of 'distributed agency' as a way to bridge this no-man's land and explore how it could figure into longer term efforts to promote sustainable energy consumption. After clarifying the notion of agency and how it will be used in the paper, I will outline the technology progressivist position, the counter-posed behaviouralist position and then develop the theory of distributed agency. Using the examples

of air conditioning and food refrigeration, I show how the technology progressivist paradigm can neither explain changes nor ought to be used as a basis for long term policy. Finally, I reflect on how a new conceptualisation of technology agency might form a basis for encouraging deeper changes in energy use and energy-related climate gas emissions.

An exploration of the concept of agency is central to this paper. What do I mean by agency? Agency, agent and agentive are words that have subtly different meanings in differing academic and policy domains. Agent can variously stand for a type of organisation (International Energy Agency); a facilitator (travel agency), an actor or player (for example the World Bank is an agent in development aid); and more. In this paper I use the agent and agency as it is broadly used in the social sciences and the science of technology, which synthesised in the following definition: *agency is the capability or power to be the source and originator of acts.*

Some of the most important debates in social and technological theory centre on agency. Is it social structures or individuals that have this power to originate acts? Does agency lie in the established routines or norms of a social group or in its ideologies? In the modern world of globalising information, how much agency does media have in influencing action? Most of us who work in the realm of energy efficiency are by now cognizant of the debates between neo-classical economic conceptualisations of agency and that of the other non-economic social sciences, the former viewing the economically rational individual as agentive, the latter arguing for the importance of social and cultural contexts (see Wilhite 2001 for a review and analysis of this debate). Another important agency-centred debate stems from Michel Foucault's (1967) claims about the power of discourses on our ideas and practices about body, sex and what constitutes 'normal' mental health. Ranged against Fourcault's discursive power are the arguments of anthropologists like Clifford Geertz, who sees Foucault's discourses as overly deterministic and argues that it is not discourses, but culture that empowers behaviour (see Ortner 1999 for an analysis of this debate). According to Geertz, people construct meaning through their imaginations, hopes, and desires (what he calls soft facts). It is culture, not discourse that is agentive.

Another important debate revolves around the relative agency of producers and consumers in determining how people consume, addressed by sociologist Giddens (1979) and anthropologist Appadurai (1996). Appadurai writes that the "real seat of agency" in consumption lies not with "the consumer but the producer and the many forces that constitute production (Appadurai 1996:7)." By promising better, more exciting, or sexier lives through acquisition of things, marketing promotes the illusion of free consumer choice. "These images of agency are increasingly distortions of a world of merchandising so subtle that the consumer is consistently helped to believe that he or she is an actor, where in fact he or she is at best a chooser (1996:7)." Many would say that Appadurai overstates the agentive power of producers, but the contention that agency is shared is important. Two papers that discuss the relevance of this debate for energy efficiency are Blomstein et al. (2001) and Wilhite (2001).

To return to the focus of this paper, I will examine the agency embedded in the material world and in the technologies that increasingly constitute it. The argument will be that both things and the social contexts of behaviour are agentive in energy consumption. Before developing the argument I trace the development of the two opposing views of agency represented in technology progressivism and behaviouralism.

Technology progressivism and the rise of behaviouralism

A good example of technology progressivism is the concept called 'leapfrogging', introduced in the landmark UN study that resulted in the book Our Common Future (WCDE 1987) and in the textbook by the same scientific contributors, Energy for a Sustainable World (Goldemberg et al. 1988). The assumption is that new, modern technologies can be made to leap into production and into daily life elsewhere around the world, where they will induce another leap over energy and environmental problems that rich countries incurred in their own development. Technologies are visualised as silver bullets that will cleanly take their place in everyday life, increasing the efficiency of achieving a given energy service (comfort, cleanliness, food or mobility) without having ramifications for other practices. The same sort of thinking is applied to households and commercial entities in Europe and North America: the path to moderating energy use is by getting energy-efficient technologies into sites of end-use. The problem is that inserting new and more efficient devices may affect energy use quite differently than that predicted. I will exemplify this point for refrigeration and space cooling below.

Frustrations with the failure of the technology-efficiency policy regime to deliver on its promises resulted in the rise of the 'behaviouralists' in the 1980s (Wilhite et al. 2000). Their view challenged technology progressivism, arguing that the 'subject' – usually referred to as the 'end-user' in energy studies - is absent. Citing numerous studies in which homes with similar sets of technologies have had widely varying levels of energy use, they propose that agency lay not with the technology but with the idiosyncratic user. In this camp, the user is completely agentive in consumption. It is she or he who 'domesticates' the technology in ways that were not intended by the designer (Sørenson 1997). Reductions in energy consumption will be achieved through changes in user attitudes, lifestyles, values and so on (see Stern 2006 for a summary of these perspectives). In short the behaviouralists move agency from the technology to the user. Figure 1 illustrates the separation into the two camps and their opposing views of agency in consumption. The behavioural camp is intentionally drawn proportionately smaller as this reflects the reality in energy research and policy.

While most social scientists would agree that consumption is more than a matter of individual behaviour, they have neither given much attention to technology. This is curious, because anthropologists regard the use of tools (technology) as an important differentiator between humans and other life forms. Simple technologies for hunting, food, heat and light are regarded as the beginnings of social organisation and co-operation.

Moving closer to the present, from the beginning of the 20th century, mass production and consumption has resulted in a material world dominated by complex technologies, such as refrigerators, televisions, cars and the legions of technologies

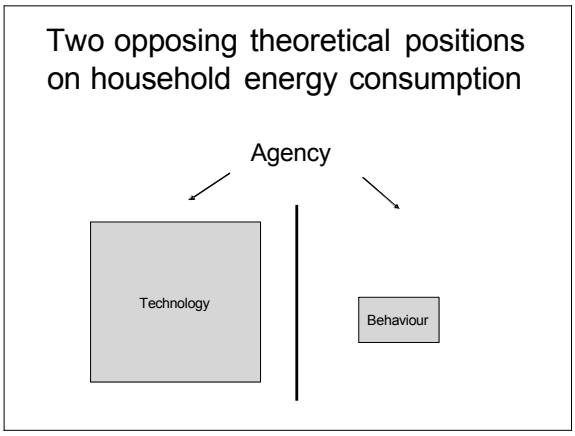

Figure 1. Opposing theoretical assumptions about the role of technology in consumption.

that they are in turn dependent on. Today, whether they be produced locally or distantly, and whether they be simple and transparent or complex and impenetrable, all kinds of technologies populate daily life virtually everywhere. Yet while the role of goods, material artefacts and commodities in consumption have all received considerable attention by social scientists, technology has not been given much attention.[1] This is unfortunate because technologies distinguish themselves from goods and from the general category of commodity in important ways, a point I will develop in the next section.

A recent policy study initiated by the Norwegian government illustrates perfectly the division of the energy policy world into the two camps illustrated in figure 1. In an attempt to acknowledge the importance of both technology and behaviour to reducing climate gas emissions, the Norwegian Parliamentary Commission split its analysis into two parts (NOU 2006). One group examined the potential for reduction of climate emissions under the heading of technology and another under the heading of behaviour. This separation precluded an analysis of the mutual interaction between technology and behaviour. This is problematic because the acquisition of technologies obviously involves behaviour (purchase behaviour) as does their use. The commission ignored the important theoretical point that agency is distributed between consumers and technologies.

The transformative potential of technology

In this section, I argue for a theoretical shift from compartmentalised to distributed agency. The first important point is that modern household appliances such as televisions, refrigerators, microwaves and air conditioners have embedded in them expert knowledge and latent uses that may never have been imagined by the purchaser. Secondly, these technologies are only the tip of an interlinked regime of technologies the greater part of which is opaque to the user. Just imagine the technology that will bring my verbal presentation of this paper to the listener. The microphone is complex enough in itself, but the technology in fact extends far beyond the room. In today's integrated energy market, there is no way of knowing where the electricity is produced, but if we were in Norway, its source would most likely be a hydropower system. Looking back toward the site of production, the electricity that powers the microphone enters the room through a wall socket. Following the wiring beyond the building, it leads to a transformer that steps the voltage down. Beyond the transformer are more wires and supports, leading to the base of a mountain. Somewhere near the base, a turbine and generator are activated by falling water. The water has been directed down through a system of pipes from a reservoir on the mountain above. This reservoir is connected to others through a system of underground tunnels. The levels of the reservoirs are regulated from a satellite, using communications technology and a sophisticated software control system. None of this is accessible to scrutiny by the average consumer, and if it were it would be beyond her or their comprehension. The point is that with these and many of the common household appliances, their complexity, lack of transparency and multiplicity of functions imbue them with agency in consumption.

The subject of technology agency has a long history in the philosophy of science. Phenomenologists such as Edmund Husserl, drawing on Kant, developed what has been designated a praxis philosophy.[2] In this, things and their uses were conceived of as being imbued with certain forms for knowledge. This was distinguished from what they called moral knowledge, involving ideology, cognition and perception. For Husserl and for philosopher of technology Martin Heidegger, technology should not be regarded as an inert object but as something embedded with agency. As Heidegger put it, things have their own kind of knowledge.

Don Ihde (1990) is a contemporary philosopher who has built on Heidegger's views on technology agency. In one of his writings he illustrates this agentive view of technology with an example from the topical debate around gun control in the US. A popular slogan, and bumper sticker, produced by the National Rifle Association says: "Guns don't kill people: People kill people." Now probably the first reaction of most readers would be to support the sentiment that to get to the root of the problem of violence and killing in the US one has to do something about the social and political contexts of violence. However, Ihde points out that there are embedded potentials in the technology that make it very efficient at violence and murder, as well as providing the latent potential for unintended deaths, attested to by the thousands of Americans who die every year in accidental shootings.[3]

In Europe in the 1980s, Wiebe Bijker, along with John Law and Bruno Latour founded a research domain called the Social Shaping of Technology (SST) (see the contributions to Bijker and Law 2000, first published in 1992). One thread builds on the Heidegger view that technology is embedded with agency. Applying this idea to home technologies, it is useful for under-

1. Well known examples being Mary Douglas's and B. Isherwood's (1979) work on the ways people use goods to make sense out of their social worlds; Daniel Miller's (2001, 1998a, 1998b 1995a, 1995b, 1995c, 1994, 1987) work on material culture, mass consumption and shopping; Arjun Appadurai's work on the nature of commodities and on their global flows 1996; 1986); James Carrier's work on the social meaning of markets (Carrier and Miller 1999).

2. This is one of the inspirations for Bourdieu's (1977) practice theory, which essentially poses that important aspects of the socio-cultural world are embedded in everyday routines.

3. In 2006 US Vice President Mr. Cheney, a prominent member of NRA, accidentally shot and wounded one of his hunting partners. I wonder if he would still go along with the slogan that it is people and not guns that kill people – if so, he would have been in big trouble if he were a better shot.

standing the interrelationship between technology and practice. Madeleine Akrich, one of Latour's students, wrote that the designers of technologies embed quote "their vision of (or prediction about) the world in the technical content of the new object." She called this a "script" or a "scenario"… "a framework of action together with the actors and the space in which they are supposed to act (2000:208)."

These 'frameworks for action' are important to theorising changing household energy consumption. In order to illustrate the point, I will take two examples from my research on consumption change in Southern India, in the State of Kerala. Kerala is interesting because consumption of all kinds of goods from soaps and beauty products to household appliances is growing. Consumption of the so-called household durables (appliances and cars) is growing very rapidly. For example, sales of washing machines increased by 500 % from 1991 to 2001 and by 30 % yearly from 1999 to 2001. Since the mid-1990s, sales of air conditioners have increased dramatically. 3 % of households owned them in 1993 compared to 15 % household ownership a decade later. This increase in the consumption of household appliances is behind the near doubling of electricity use in Kerala's capital city Trivandrum between 1995 and 1999, an increase that took place in spite of a 30 % rise in electricity prices during the same period (Vijayakumar and Chattopadhyay 1999). The consumption of automobiles has grown rapidly as well, increasing by 50 % from 1990 to 1995 and then almost doubling from 1995 to 2001. In 2002, 40 % of middle class households in Trivandrum owned a car.

FOOD REFRIGERATION

How is consumption of these appliances affecting practices? Food refrigeration provides a good example. Refrigerators were introduced in South India in the 1960's, yet far fewer families have them today than have televisions (60 % today own refrigerators and 97 % televisions). When the refrigerator reached Indian markets, why did it not rapidly achieve the status of absolute necessity, as it has in the West? As I dug into this, I found that most of the elderly generation who had bought refrigerators surprisingly (for me) did so not to enable the storing of leftovers and cool drinks, but to save space. Raw foods such as eggs, food, ghee and vegetables were spread out on shelves in a cool place. Many homes had an entire room dedicated to cool storage of raw foods. People who bought refrigerators were most interested in buying a refrigerator in order to free up space for other things. After they had purchased a refrigerator, one of the families in the study converted the food storage room to a TV room.

After I completed my field work in India, I came across a study by Garnett's (2007) of changing food refrigeration in the UK. She points out that as late as 1970, only 60 % of the UK population had a refrigerator. Her research indicates that refrigerators replaced food cellars and cool rooms as the preferred place to store foods. In fact she argues that changes in housing design, with the elimination of cabinets and shelf space for food storage, and the increase of central heating, both contributed to increased interest in refrigerators. Thus in examining the initial reasons for the purchase of refrigerators, this relationship between space and food refrigeration is important in both Great Britain and India. However, once inserted into home practices, the refrigerator bears with it potentials for significant changes.

For the middle-aged and elderly generations in Kerala, neither cooling drinks nor storing left-over dishes were intended as uses for their refrigerators. In fact, there is a widespread scepticism to eating food that has been stored, as well as to imbibing cold foods and drinks. This is especially strong among Hindus (about 60 % of Trivandrum dwellers are Hindu, about 20 % are Christian and fewer than 10 % are Muslim). Of the Hindu participants in a survey of 400 middle class families only 32 % said that they regularly drank chilled soft drinks, compared to about 50 % of Christians. At least part of the explanation for this difference can be attributed to Hindu food ideology and the associated Ayurvedic health tradition. Imbibing chilled food or drink, or reheating cooked foods is said to lead to sluggishness, laziness or even stupidity. Leftovers are thought of as dead and are to be avoided. On the other hand, freshly cooked foods are thought to be 'alive' and give life to the eater.

Deeply held ideas about food contributed to limited interest in the refrigerator in Kerala over a period of 40 years and 2 generations. However, interviews with families in their 20s and early 30s reveal a new refrigerator use pattern and changing ideas about food. Many of the younger families regularly prepare food in bulk and serve it up after it has been stored for days in the refrigerator or freezer. What is behind this change? My interpretation is that changes in the social context of home and work are activating the refrigerator's latent potential to save time. Women are entering the work force in increasing numbers, yet working wives still have exclusive responsibility for preparing and serving food (and accomplishing all of the other household chores). Another factor involves the breakdown of the joint family household, where adult women shared chores. Today, more than 90 % of households are nuclear households in which wives stand alone with all chores. Thus social changes have activated potentials in the refrigerators to change food practices. To put it another way, agency in changing food consumption is distributed between the latent potentials in the refrigerator technology and the changing social contexts of everyday life.

Let us explore this distributed agency between technology and social context further with another example involving home cooling.

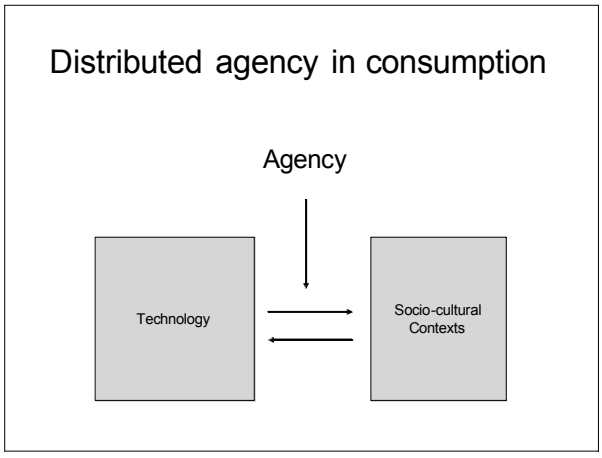

Figure 2. Distributed agency in consumption.

HOME COOLING

Air conditioning is a technology which is literally colonizing home cooling over much of the tropical world. The technology was developed, perfected and eventually dominated indoor space cooling in the United States over the course of the middle of the 20th century (Cooper 1998; Shove and Wilhite 1999). Then as a mature technology, air conditioning made a rapid advance into Japanese commercial buildings and homes in a 30 year period from 1960 and 1990 (Wilhite et al. 1997). In the emerging economies of recent decades, such as those of India and China, air conditioning is growing rapidly. I will draw on my recent India research to address the reasons for these changes.

In Kerala, there was very little air conditioning in any kind of building until the mid-1990s. From 1991, with the opening of the Indian to foreign investments, foreign manufacturers and foreign products, prices of air conditioners dropped substantially and the numbers and models available increased rapidly. Import restrictions on foreign produced air conditioners were eliminated in the mid-1990s. Altogether, retail prices of air conditioners fell about 20 % from the early-1990s to 2001. During that same period, loan institutions, working together with air conditioning retailers began offering customers the option of paying for their purchase in instalments spaced out over two years with very low interest rates. These dramatic changes in price and availability are an important part of the explanation for increases in the purchases of air conditioners. However, the point I want to emphasize is that the stage had already been set for these changes more than a half century earlier, with the change from local climate adopted building construction to generic entrepreneurial building practices.

Well into the 20th century, building of homes and public buildings in Kerala was done mainly by caste-based craftsmen (the *viswakamos* caste). Their building principles took account of Kerala's hot and humid climate and included the use of tree shading, natural ventilation, and orientation of the house to capture breezes. Artisans used wood, mud, unburnt bricks, bamboo, straw and leaves as building materials -- all porous materials that allow natural ventilation. In the mid 20th century new building regulations were put into place that called for written proposals for new buildings. This disfavoured artisans who lacked the writing and drafting skills to produce site plans and blueprints. Building contractors began to take over house construction. There was a capitalization of the building industry with emphasis on cost minimization, the use of unskilled labour, and the use of cheap pre-fabricated materials.

During the period of my first field research in Trivandrum in 2001/2, my family lived in one of the rare houses built in the 1950s which was designed for natural cooling. Some of its features included a long central corridor built in the direction of the predominant breeze, with a surrounding screened porch and a shaded interior. It was quite comfortable without air conditioning. On a return visit in 2003, we lived in a house similar to the one pictured below, built in a style that has predominated after the 1960s. During this period, the principles of climate adaptation largely disappeared from housing design. Cement plaster or burnt bricks, both of which are non-porous and have poor thermal properties in hot and humid climates became the favoured building materials. Roofs, which were

Figure 3. A typical middle class home in Trivandrum, Kerala (South India)

earlier constructed from thatch or locally produced tiles, were replaced with flat, concrete roofs that trap heat. Concrete was also favoured by the coming of electricity and water infrastructures. It was used to support wall constructions that would house plumbing, pipes and fixtures. Today, 84 % of homes in Trivandrum middle class neighbourhoods have concrete roofs and many have second stories. The second story in the house we rented in 2003 was virtually uninhabitable due to heat gain from the flat, concrete roof. For houses of this type, the air conditioner provides the potential to revive living spaces that are otherwise unliveable.

These developments that took place over the course of a century in India reveal that the regime of technologies involved in house construction has literally paved the way for air conditioners. Of course, the benefits of air conditioning are the subject of heavy marketing. Advertising in India draws on an important metaphor that was pioneered in Japan. The message is that the family that buys and uses an air conditioner enters the modern world without leaving tradition behind. A good example from early Japanese advertising is an advertisement for a Mitsubishi air conditioner from 1967. It showed a traditional Japanese room, with tatami floors, traditional decoration and a women kneeling in the foreground in a kimono. Prominently visible on the wall behind her was a Mitsubishi air conditioner. The décor and furnishings of the traditional Japanese home were remade in this and other advertisements to include modern appliances (Wilhite et al. 1997). A good example of Indian advertising of 2001 is a Carrier (a US based air conditioning manufacturer) television advertisement. In the first image a holy man (*sadhu*) is lying outdoors on a bed of nails in a hot, dirty and dusty street. In the second, he is lying in precisely the same position on a comfortable bed in an air-conditioned bedroom. Fernandes (2000) writes that "In both photographs, the *sadhu* is depicted in exactly the same position, reclining with his eyes shut…The core of Indian tradition, the image suggests, can be retained even as the material context of that tradition is modernized and improved."

The situation in Kerala today is that building contractors routinely incorporate air conditioning in their designs for middle class homes. Even for someone motivated by a desire for a

natural, traditional or environmentally-benign design, alternative designs are hard to find and the use of alternative building materials expensive. There is no doubt that the culmination of this century long scripting of air conditioning is contributing to South India's serious electricity deficit. The use of the air conditioner is one of the main reasons for the doubling of household energy consumption in a four year period at the end of the 1990s and an increase in the contribution of residential electricity consumption to total electricity use from 16 % to 44 %. As a result, power blackouts, both planned and unplanned are increasing. This means that those who have air conditioners can only use them sporadically and unpredictably.

Will the future of Indian cities resemble that of Japanese and Southern U. S. cities, where both living and working environments are today virtually totally air conditioned? In Tokyo, the electricity demand created by air conditioning has become so acute that businesses are being asked to shut down air conditioning (for which they receive a preferential tariff) and suffer the heat and humidity through several hours each day. The opposite phenomenon of that described above is occurring; instead of air conditioners making spaces liveable, people are being forced to live and work in spaces divested of the air conditioning for which they were designed.

In many parts of the Southern United States, air conditioning has become the most important determinant of the geography of everyday life. There is virtually no home in central Florida today without central air conditioning. This history of my parent's home is representative. It was constructed in the 1940s in what was called 'Florida style', the term coined to mean a house able to function in the local climate without conditioned air. Important building characteristics were one story, low ceilings, screen porches, exit fans to draw out hot air and lots of shading. By the mid-1960s air conditioners were installed in all the bedrooms. In the 1970s the screens on porches were removed and replaced with glass. A central air conditioner replaced room air conditioners. The amount of space to be air conditioned was increased and in fact the glass porches added heat that in turn demanded more cooled air. These are developments shared by homes and neighbourhoods all over the Southern United States. On a typical day for my brother, he leaves his air conditioned house in the morning, gets into his air conditioned car and drives to his air conditioned office. After work he usually stops at one of the many air conditioned shopping malls. For him, walking, shopping, eating and entertainment are all associated with artificially cooled environments. Moving outside that conditioned world is regarded as hazardous. On a visit a few years ago, when my wife and I decided to walk to the shopping mall, about a 3 km walk, my family reacted with great distress. They all scrambled to offer their car (air conditioned of course). We bravely declined. However, after we started our trek, we found that after a few blocks the sidewalk simply vanished. Nobody walks anymore.[4] Sidewalks have been made obsolete in this air conditioned lifeworld.

4. Ironically, many people do walk as part of fitness regimes, but almost no on walks in connection with shopping or other chores.

Implications for energy efficiency theory and policy

These examples show that technologies are not silver bullets that enter seamlessly into household energy practices. Efficient technologies may take the top off of projected energy use and emissions, but the bottom line may still be much greater energy use than imagined in theoretical models. This is because technological devices bear with them embedded potentials for changing practices. New technologies do not determine new patterns of consumption, but create potentials for change that connect with changing socio-cultural practices in and outside the home. In other words, agency is distributed between technologies and the socio-cultural contexts of consumption.

The regime of technologies which makes up the home bears with it particularly powerful scripts for change. A pattern that is repeating itself everywhere is that while homes get enveloped by global markets and capitalist building principles there is a tendency towards the use of materials and designs that do not cope well with heat and humidity. In this change, the technology regime is highly agentive as well as being highly problematic from an energy and environmental point of view. An energy efficiency policy aimed at reducing energy use and climate emissions from space cooling will need a powerful and active intervention in order to re-script cooling consumption in a less-energy intensive direction. For countries of the South and those in milder climates such as the European climate, these new housing technology regimes are less intrusive thus far than in North America and Japan. There is still a window of opportunity in Europe for arresting the development towards air conditioning before it colonizes practice. Natural cooling has been the norm for many generations of Portuguese, Spanish, Italians and French. The promotion of efficient air conditioners in these areas should not be regarded as sustainable energy policy (as has been suggested by many in the energy policy community) Policy should rather be aimed at supporting a reinforcement of the existing natural cooling technologies, making an effort to identify how pockets of discomfort can be neutralised.

Food provisioning and the use of refrigeration are also characterised by powerful technology regimes. Assuming the theoretical position put forward in this paper, we see that this is reinforced by a global increase in time pressure on households as well as changing ideas about diet and food security. As Garnett (2007:5) writes about Great Britain, where estimates are that food refrigeration contribute 3.5 % of climate-gas emissions:

> Cold chain technology is embedded in each life cycle stage of today's food system; its ubiquity means that new food products and technologies emerge that are predicated on refrigeration and as such exacerbate and increase our refrigeration dependence… the presence of refrigeration has in turn shaped the development of the sorts of foods we choose to eat, of the way we shop and of the way we cook. Refrigeration is now essential because the foods we now consume and the frequency with which we shop are predicated on refrigeration. In short, refrigeration has made itself indispensable.

Can and should sustainable energy policy take on refrigeration and if so how? As with space cooling, the current focus on ef-

ficient technology will only at best clip the tip off of the iceberg. Longer-term, deeper changes will require a broadening of focus to include an examination of new ideas and practices associated with food security, food waste, dietary practices, food marketing, spatial location of food stores and food shopping habits, to name a few. At this point, this shift in focus is imposing and there are no easy short term solutions. For the longer term we need to lift the horizon of policy focus to address how regimes of cooling technologies and practices can be changed.

In conclusion, I reiterate that attempts to remake the world in a more sustainable direction do not begin with a blank material slate. Much of the material landscape is already embedded in or enshrouded by technology. Buildings, transportation systems, water and energy are all organised into inter-linking technology regimes that together don powerful scripts for consumption (see also the contributions to Southerton et al. 2004). When it comes to energy use, these material scripts tend to push both consumers and producers towards increased energy use. The replacement of one technology with a more efficient one may reduce the energy input but not the total amount of energy demanded for the energy service, whether it be comfort, food, entertainment, transport or any of the other services energy provides. The implications of the line of thinking outlined in this paper are that behaviour and household technology are mutually implicated in the demand for these services. The idea of distributed agency provides one way of re-coupling them in theory and opens new vistas for the policy domain that today designates itself 'energy efficiency.'

Leveraging the theory of distributed agency may be one way out of a policy domain ensnared by the paradigm of technical efficiency. It would involve a design process for buildings and neighbourhoods that anticipates how energy demand is embedded in the material world and is self-conscious about the ways technologies script energy-using practices in sometimes unintended ways. A long term technology policy would take account of the socio-cultural contexts into which technologies fit and would draw technologists, social scientists and energy consumers into the design process.

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