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Linking Utilities and Users

The title of this chapter serves multiple purposes. It is partly an injunction: a reminder that providers and consumers are jointly implicated in the management of waste, energy and water. It is also an intellectual ambition. As we explain in this chapter, new tools and resources are required to conceptualize and analyse changing relations between utilities and users.

Energy and water consumption and waste management have significantly different qualities as 'environmental' issues. Given current forms of generation, escalating demand for energy – and, in particular, for electricity – has rather direct consequences for carbon dioxide (CO_2) emissions and hence for global warming. The environmental impacts of water consumption are often more obviously local since they are to do with the relation between abstraction and changing ecosystems. As with electricity, much depends upon the nature of the infrastructure and associated possibilities for managing distribution and flow. Meanwhile, waste can constitute all manner of environmental 'problems', depending upon the properties and the volume of the stuff itself. More abstractly, waste counts as an environmental issue not simply because of toxicity or degradation, but because it signifies profligacy and the unsustainable consumption of non-renewable resources.

By bundling these diverse concerns together, conventional definitions of sustainable development as that which 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987, p43) treat 'the environment' as one. Consistent with this approach, policies to promote sustainable consumption are generally designed to reduce the size of the ecological footprints associated with contemporary forms of consumer behaviour (Wackernagel and Rees, 1995). Strategies of this kind almost always focus on the actions and decisions of individual consumers. Having defined the problem – and the solution – in terms of consumer choice, the central policy challenge is that of persuading people to make 'the

environment' their preferred brand and to opt for goods and services that are less resource intensive to provide.

As these paragraphs imply, 'the consumer' and 'the environment' are constructed in ways that have far-reaching but often unintended consequences for the conceptualization of sustainability and for the sorts of initiatives developed in its name. One purpose of this chapter is to revisit dominant theories of 'green' consumption in order to show how well, and how badly, they apply to the use of energy and water and the management of waste. This is an important task. If energy, water and waste really are vital environmental issues, failure to adequately conceptualize their consumption represents a serious problem for those seeking to reduce demand.

It is immediately apparent that 'the utilities' have certain distinctive qualities. One is the extent to which we have become dependent upon their consistent and reliable supply. As Hutton explains, major power failure 'rams home to ordinary people what otherwise exists only as a theory. Electricity is not a commodity like a designer dress where an interruption of supply poses no wider consequences; it is a precondition for successful modern life' (Hutton, 1998, p24). More ordinarily, but just as important, forms of energy and water consumption are routinely invisible. There are two aspects to this. One is that utility bills come but once a quarter and it is by then impossible to relate the levels of consumption shown to the past practices that occasioned them. The other is that resources are consumed not for their own sake, but in the course of achieving services such as those of heating, bathing, lighting, cooling etc. The use of energy and water is consequently mediated by a battery of intervening technologies (baths, light bulbs, boilers), and by an array of social and cultural norms and conventions, including those of comfort, cleanliness and convenience. In addition, and as we explain below, relationships between supply and demand are complicated and co-constitutive. As a result, the manner in which resources are provided is itself important for ensuing patterns of consumption.

In this chapter, and in the book as a whole, we investigate the relationship between consumption and provision, focusing on the consequences that changing systems of provision (notably from monopoly providers to competition in liberalized markets) might have for energy and water demand and for the management of waste. In principle, organizational transformations generate new and different possibilities for environmental reform. For example, it is now possible to imagine the development of highly localized systems of embedded generation and of massive pan-European networks, neither of which were easy to picture under conditions of national monopoly. Rather

than focusing on the technological efficiencies of one scenario or another, we argue that the environmental implications of institutional change depend upon the relation between provision (supply) and consumption (demand), and upon the links that are forged and broken between utilities and their users.

The rest of this chapter makes the case for re-conceptualizing the relation between provision and consumption – and, in particular, the consumption of domestic utilities. Critically, we argue that patterns of consumption follow from and reflect the effective accomplishment of what people take to be normal routines and practices. We make the further claim that understandings of normal and ordinary routines change in ways that are at least partly related to the systems and technologies through which they are defined, delivered and provided. Equally, models of need and assumptions about demand are quite literally built into networks and infrastructures of provision. Though invisible to any one end user, such assumptions are, nonetheless, important in establishing, challenging and stabilizing demand.

The idea that systems of provision and patterns of consumption constitute each other has important implications when thinking about the practical, cultural and political implications of institutional change. We discuss the differentiation of energy, water and waste and the production of multiple varieties of each in terms of newly constituted relations between consumer and provider (see also Chapter 4). In detailing the cross-cutting consequences of utility reform, we explore the environmental implications not of one system versus another, but of an increasingly diverse institutional landscape marked by correspondingly varied sets of consumer–provider relations.

Green consumption

We begin by characterizing three ways of conceptualizing green consumption, an exercise that allows us to position our own approach and show how it differs from other models and theories.

Switching commitments

The view that the fate and future of the planet depends upon the cumulative consequences of what people do in their role as relatively autonomous shoppers is immensely pervasive. It is also a view that justifies a 'focus primarily on individual behaviour because programmes and policies aimed at reducing consumption ultimately must alter the

consumption decisions made by individuals' (Brown and Cameron, 2000, p28). The idea that consumers respond to social, economic or psychological stimuli has inspired repeated rounds of research into the determinants of decision-making. If researchers could figure out just what the triggers are, policy-makers could design packages of incentives, information, signals and prompts with which to generate desired forms of behavioural change – or at least that is the hope. In following this path, commentators have been drawn into a maze of motivational psychology and economics in which consumers' actions are explained with reference to a cocktail of competing concepts such as those of altruism, status-seeking, identity, and rational calculation (Uusiatalo, 1990; Moisander, 1995). A central assumption is that green consumer practice depends upon and reflects underlying values and commitments – hence efforts to instil awareness of the global consequences of individual action.

In the UK, Powergen's Bright Sparks programme is typical. This scheme involved giving school children 'a free, low-energy lamp and a questionnaire on energy use. Families were able to buy a second lamp at the reduced price of UK£3, with £1.50 of this going to the school.' According to Powergen's promotional material: 'The project increased energy awareness among children aged between 7 and 11, saved energy and is reducing electricity bills by UK£3.1 million. Over 47,000 customers are benefiting' (Powergen, 2003).

Initiatives such as these have a number of features in common. First, and as this case illustrates rather well, the focus is on the efficiency with which services are provided. As a result, questions about changing conventions and standards of lighting simply do not arise. As in so many other situations, contemporary expectations are naturalized and normalized: they figure as non-negotiable requirements that simply have to be met. Second, such programmes are founded upon a particular model of individual choice and agency. The underlying assumption is that consumers can reduce the weight of their personal environmental 'rucksack' if they choose to do so and if they have the necessary knowledge. Last but not least, although Powergen's programme positions families as end-consumers, it tacitly acknowledges that the household infrastructure is part of the electricity network as a whole. By giving away low-energy lamps, this company is, on however small a scale, changing the demand profile and, hence, the sorts of challenges it faces as a provider.

To summarize and simplify, much environmental debate positions consumers as key 'switches' in the environmental system. Turned in one direction and the 'metabolism' of society is endangered, turned another way and it is potentially preserved (Noorman and Uiterkamp, 1998).

Influencing the environmental options on offer

Spaargaren and Van Vliet (2000, p70) argue that there is more to consumption than shopping and that environmentally committed consumers have the power and the potential to shape the range of options on offer. In this account, green consumers figure as political actors, able to vote with more than their feet in support of collective projects like those of environmental reform. The hope, here, is that there might be a tide of 'environmental innovation ... initiated by the wish of the consumer' (Spaargaren and Van Vliet, 2000, p70) and carried along by a groundswell of popular demand. Whether this, in fact, occurs or not, the key point is the recognition that consumers have a hand in shaping options as well as exercising choice between them. As Van Vliet puts it, people are not simply end-consumers entirely isolated from the production process; in reality, they too 'participate in the organization of production–consumption cycles' (Van Vliet, 2002, p53). This can take different forms. For example, Van Vliet distinguishes between situations in which consumers opt for 'green' electricity tariffs and in which they are themselves providers, owning and using photovoltaic systems and perhaps selling 'green' power back to the grid. Developing these ideas, proponents of ecological modernization claim that when prompted by consumer demand, capitalist society can be restructured around ecological goals. More than that, they believe that with new technologies and forms of organization in place, the sustainable delivery of goods and services we have come to take for granted is a real possibility.

For this to occur, policy-makers have to take a broader view of the relation between consumption and production. Spaargaren (1997, p193) consequently recommends that policy should 'not limit itself to consumer behaviour ''on the market'', but should also be directed at intermediary organizations and systems which can have a direct influence on changes in household consumption patterns'. For policy, the challenge is one of helping consumers find ecologically rational ways of achieving the goals of daily life and of putting their green commitments into practice. As above, the focus is on resources rather than services and, again, contemporary conventions and standards are not, in themselves, called into question.

Reproducing more and less sustainable ways of life

A third set of arguments revolves around the proposition that patterns of consumption follow from the routine accomplishment of what people take to be 'normal' ways of life. As Røpke puts it: 'consumption is

woven into everyday life' (Røpke, 1999, p403) and must be analysed as such. This conceptual move shifts the focus of attention from moments of acquisition to routines of use. Just as important, it locates people as 'practitioners' rather than 'consumers'. The dynamics of practice take centre stage for the view is that different forms of consumption, some more sustainable than others, follow in the wake of changing conventions of everyday life. In this analysis, people's routines and expectations reflect shared systems of social and cultural order. Taking a strong line, Reisch (2001, p374) goes so far as to argue that 'the non-stop society forces consumers to adopt lifestyles which are unsustainable'. This is so whatever the strength of their environmental commitment.

The idea that people are obliged to consume in order to be part of society raises a host of further questions about the relation between consumption and the production and reproduction of social difference. Bourdieu (1984) and Douglas and Isherwood (1996) have, for instance, written about how the symbolic significance of specific forms of consumption evolves. Drawing upon a rather different literature, Rip and Kemp (1998) conclude that concepts of normal and ordinary practice are intimately related to trajectories of technological and institutional change. Accordingly, technological improvements in the provision and consumption of energy and water are important not (only) because of associated efficiencies, but because tools and infrastructures shape (while also being shaped by) taken-for-granted conventions, practices and ways of life (Shove et al, 1998). In other words, technological 'fixes' to environmental problems are themselves infused with concepts of sufficient and normal practice.

To generalize and, again, simplify, these ideas suggest that patterns of sustainable consumption require and depend upon the development of correspondingly sustainable socio-technical regimes. For environmental policy, the challenge is to identify critical moments or turning points at which socio-technical trajectories and the ways of life associated with them might be nudged, if not 'steered' in a different direction. In practice, this means looking for opportunities to modulate pathways of transition through considered forms of strategic intervention, and facilitating interaction between the many actors involved in configuring sectors, services and institutions. Such methods do not revolve around the 'end-consumer', nor do they imply or require explicit commitments to specifically environmental goals. The emphasis is, instead, on the socio-technical, political and historical structuring of everyday life, with all that entails for patterns of consumption.

Representations of consumers as shoppers, citizens or practitioners generate different ways of thinking about how utilities and users interact

and, hence, about what is at stake in 'greening' the connections involved. The next section explores these differences in more detail.

RESOURCES, SERVICES AND INTERDEPENDENT PRACTICES

Not surprisingly, energy policy-makers and regulators are preoccupied with resources (electricity, gas, oil, etc.) and with the rate at which these are consumed. Efforts to influence consumption, whether through prices, regulation or information, reflect this resource-based approach. So, too, do more conceptual models of households as input–output systems through which resources flow (Noorman and Uiterkamp, 1998). Gatersleben and Vleck (1998, p142) define household metabolism as 'the conversion of energy, water, material goods and services into various household functions and waste products' and go on to describe a somewhat mechanical system in which 'needs', 'opportunities' and 'abilities' combine to determine levels of environmental impact. This model is one in which individual decision-making informed by higher-level societal concepts of 'need' determines resource flows through the 'system' as a whole.

In practice, and as utilities and policy-makers are beginning to realize, metaphors of engineering and flow are of little value in understanding the practicalities of consumption. There are several reasons for this. One is that although people pay for the electricity and water they use, these are not conventional commodities. What actually matters, at least to consumers, is the services that these resources make possible. In other words, people consume electricity and water in the course of engaging in an extraordinarily diverse range of practices, including bathing, laundering, heating and cooling, cooking, watching television, using a computer and so forth, each of which has a trajectory and a dynamic of its own. While energy and water bills record resource use, they tell us little if anything about the services that are thereby delivered and that are, in a sense, the real 'objects' of consumption.

If we conclude that services, not resources, should be the focus of attention, we have to re-conceptualize the relation between utilities and their users. At the very least we have to recognize that this relationship is mediated by a complex array of intervening technological systems through which consumers are, quite literally, connected to wider infrastructures of provision.

Clear-cut distinctions between consumers, on the one hand, and providers, on the other, do not adequately account for all of the

intermediate institutions and socio-technical systems involved. It is, for instance, important to keep sight of the point that energy- and water-consuming devices such as night store heaters, power showers, washing machines and freezers are themselves appropriated and 'domesticated' (Lie and Sorensen, 1996) with reference to existing, but nonetheless dynamic, concepts of appropriate domestic practice. As numerous authors have observed (Strasser, 1982; Cowan, 1983; Parr, 1999), technologies, conventions and practices co-evolve. Automatic washing machines have, for instance, transformed what is involved in doing the wash and influenced the development of new concepts, standards and senses of obligation. Kaufmann (1998) writes about these silent injunctions in a way that illustrates the relation between the recurrent performance of a practice (like doing the washing) and its development as an emergent entity – that is, as a set of conventions that inform future performances and, hence, future forms of consumption.

There are other interdependencies at play in developing, sustaining and operating utility networks (Shove and Chappells, 2001; Chappells, 2003). Otnes (1998, p120), for example, describes domestic consumption as a process of 'being served by, and serving, a number of essentially collective socio-material systems'. Each time we switch on a light bulb we are connected to an invisible hinterland of expertise, wiring, utility investment and power generation. The act of flicking the switch is, in an important sense, part of this complex system. It is so because consumers and users are actively involved in reproducing and sustaining collective socio-material and related expert systems. Networks require recurrent use in order to survive – a point clearly illustrated by the demise of previously extensive systems such as those of the telegraph or of canal-based transport in the UK.

Households may not know much about what lies behind their taps and socket outlets – Garrett (1997) reports that many UK consumers are unsure exactly who their local supplier is – but they nonetheless occupy a pivotal position as the owners and managers of the sensitive 'fingertips' of the network as a whole. In recognizing this point, Patterson (2003) makes a compelling case for extending definitions of utility infrastructures to include the buildings and dwellings that are supplied with power. Though not owned by electricity or water companies, these structures and the equipment they contain are central to the operation of the system as whole. This type of interdependence is exemplified by the experiences of an electricity company operating in rural Northumbria, in the north of England. The company has been particularly successful in persuading householders to install electric night store heaters. These devices consume cheap-rate electricity during

the night and give out heat during the day. From the utility's point of view, they are intended to help spread the daily pattern of demand. However, the campaign has been so effective that the company has created a new problem of its own making: the daily peak is now at 2.00 a.m. when all of the night store heaters kick in! There is little that can be done in response since the heaters are owned by householders, not by the utility, and as such have a dual existence as part of the regional electricity system and as part of people's homes.

The paragraphs above suggest that institutions and infrastructures are sustained and reproduced by and through the actions and practices of those who use them, *and* that these systems structure those same actions and practices. It is therefore important to review the relation between different systems of provision and the construction and management of demand.

Systems of provision and the construction and management of demand

We are used to the idea that energy, water and waste management will be centrally provided by a limited number of organizations, often state monopolies. But this is not the only option.

Fine and Leopold describe and characterize the chains or systems of provision that unite 'a particular pattern of production with a particular pattern of consumption' (Fine and Leopold, 1993, p4). Services such as housing and healthcare can be provided by the state, by private companies, by oneself, or by one's family and friends. More commonly, systems of provision involve quite complex combinations of multiple modes. As we will see, competitive and collaborative relations and interactions between producers, distributors, retailers and consumers have important consequences for the long-term construction of demand and for the design and operation of energy, water and waste management systems.

The following historical examples, one from each sector, illustrate something of what is involved and provide a general introduction to themes and tensions explored in more detail in the chapters that follow.

Providing and consuming water

Water, which is essential to sustain human life, is a natural resource and not one that is manufactured or made. In talking about how water is 'provided' and 'consumed', we are, in effect, talking about how it is

channelled, contained, distributed and treated, and about how access to it is managed and controlled. The move from communal or private wells to mains water supplies represents an important moment in the history of water provision. With this step, what Taylor and Trentmann (2004) refer to as the 'liquid politics' of flow acquired new meaning and character. Most obviously, categories such as those of provider and consumer make sense in a way that they did not before. In the UK, as in a number of other countries, the history is one in which multiple private water companies, initially set up to supply cities and metropolitan areas, were taken over by municipalities. In London, the 1902 Metropolitan Water Act bought out water companies and placed water provision in the hands of the Metropolitan Water Board, with local authority representation (Taylor and Trentmann, 2004, p6). During recent years, public-sector monopolies have been dismantled with the result that water is once again provided by the private sector.

These institutional transformations reflect changing understandings of what water consumption is about. During the late 1800s, water was strongly associated with public health, sanitation and civilization (Roche, 2000). The view was that people, and especially poor people, needed more water and a more reliable supply of it in order to maintain standards important for public health and essential for civilized society (Ogle, 1996; Melosi, 2000). Massive private investment in plumbing, taps, baths and showers – indeed, the invention of the bathroom as a whole – was inspired by logic of this kind. At the same time, such investment supposed and contributed to the development of relatively integrated systems of water provision and wastewater treatment. The parameters of water consumption relate to developments in water-using practices, such as regular bathing, and to the installation of mediating technologies, including toilets, taps, bathtubs and washing machines. Infrastructures such as the massive Thirlmere aqueduct that carries water from the hills of the Lake District to the city of Manchester or the water reservoirs built in the 'Brabantsche Biesbosch', The Netherlands, during the 1970s were, in turn, designed and sized to cope with anticipated patterns of demand (Chappells, 2003).

The fine details of just how water systems work – where and on what scale investments are made, and why – reflect the mixtures of public- and private-sector interests involved, and more abstract but often related concepts of water as a 'right', as a free good and as a scarce commodity. In the UK, newly privatized water companies have an uphill battle to persuade their 'customers' to limit consumption during times of drought. As rate payers, people had been willing to save water for the public good; but in their new role as consumers it was difficult to

see why they should cut back to alleviate problems faced by a handful of private companies.

As this section indicates, systems of consumption and production intersect. In this case, it is clear that systems of provision, including institutional modes and physical infrastructures, have consequences for, and at the same time reflect, ideas about what water is (Strang, 2004) and about the societal, as well as personal, importance of water-consuming practices.

Providing and consuming electricity

The history of domestic electrification is, in essence, a history of inventing need. Although now an essential part of daily life, electricity was first used as a substitute for a variety of existing resources, including wood, gas, oil, wax and steam. Since heat, power and light could all be provided by other means, the system builders of electricity networks (Hughes, 1983) confronted not one but a number of related challenges in figuring out where and how to position this new 'product'. Unlike water, electricity really does have to be made, and as others have explained, the practicalities of electricity production have immediate consequences for the organization of consumption. Two features are especially important. First, and again unlike water, electricity is rather difficult to store. It is therefore important to keep supply and demand in balance. Second, it is generally more efficient to keep generators and power plants running continuously.

These production-oriented considerations exerted a powerful influence over the first efforts to construct demand. What was required was not 'demand', in general, but an evenly distributed demand profile produced as a result of the voluntary actions (connections, disconnections, and switchings on and off) of a multitude of individual consumers. In order to achieve this ideal, providers had to pick consumers carefully and influence what they did and when.

To begin with, households used electricity to replace other forms of lighting, particularly gas. This generated demand for electricity during the night, but not the day. Other uses had to be constructed and new daytime and summer loads had to be built if the system was to function effectively. Hughes (1983) and Nye (1992) have written about the deliberate configuration of domestic, industrial and transport-related demand and about the public- and private-sector interests involved. In the home, electric heaters and cookers were developed, along with vacuum cleaners, toasters, washing machines, dishwashers, potato peelers and knife grinders – all appliances through and with which to

sell electricity (Forty, 1986, p87). This is not the place to describe the slow and rather erratic wiring-up of Western society. For present purposes, it is enough to notice that the potential benefits of being wired up relate to the range of electric appliances in circulation and that having a fully wired home is not in itself much value, unless one also owns an array of electrical appliances. As noted above, the acquisition, use and appropriation of things such as automatic washing machines have further consequences for what it means to wash well and, therefore, for the definition of practices and habits, many of which now 'require' appliances that, in turn, necessitate a steady and reliable supply of electrical power.

In subsequent chapters we discuss contemporary efforts to manage demand for electricity in order to reduce emissions of CO_2. We also reflect on the environmental implications of different scales of provision and, in particular, the possibilities afforded by more localized forms of power generation. In exploring these themes we keep the relation between consumption and production centre stage.

Producing and managing domestic waste

Domestic dustbins of the kind that local authorities empty on a regular basis symbolize and, in a more direct way, embody relations between the household, figuring here as the producer of waste, and the organizations involved in waste management. The very existence of these bins supposes a rather extensive infrastructure of local taxation, municipal responsibility, centralized waste planning, specialized trucks and teams of dedicated employees. Their size and form reflect further assumptions about the volume of household waste and about the frequency and method of collection. The modern 'wheelie bin' is, for example, designed to accommodate a large quantity of undifferentiated rubbish. It is also made to be picked up and emptied mechanically by a purpose-built vehicle in which the contents are crushed and carried away. While this is a scenario routinely repeated across the cities of Western Europe, such arrangements have a rather short history.

It is again a history that relates to urbanization, public health and sanitation. But there is more to it than that. For one thing, it is only recently that homes have begun to produce what counts as rubbish on any scale. In addressing this issue, authors such as Thompson (1979) O'Brien (1999) and Strasser (2000) examine the social and economic properties of waste from somewhat different perspectives. They are, however, in agreement that what counts as waste varies from one

context to another, and that analysis of this category and of what it contains provides important insight into the social organization of production and consumption.

There was, for instance, a time when worn-out cotton clothing was much sought after as a raw material for paper-making. Equally, there was a time when scraps of food would have gone directly into the belly of a local pig. Whether a rag is of value or not depends upon how scraps of fabric figure in the wider economy. The volume and nature of the 'waste' that now finds its way into the bin consequently depends upon a whole sequence of judgements and evaluations applied to materials and artefacts as they travel through the value chains of society. It also depends upon the existence of alternative destinations. For example, when open fires were common, they were commonly used to incinerate all manner of unwanted materials. As a result, there was much less to put in the bin.

This is not the place to go into the history and politics of rubbish management. For now, the important point is that changing definitions of waste have implications for the boundary between public and private responsibility, and vice versa. Having said that, there is no doubt that the contemporary economic and environmental costs of managing the waste streams of today's consumer society are considerable. Environmentally inspired programmes designed to minimize the amount of rubbish dumped in landfill sites bring with them new options, categories and classifications. For example, some require households to accept and internalize new categories, to separate different types of waste and to modify routines and practices to suit. Others do not involve separation at source. As we shall see, exactly how the 'work' of waste management is distributed and managed within the home or by an increasingly complex array of public- and private-sector organizations is of some significance for the number of fractions into which rubbish is sorted (that is, for the types of rubbish produced) and for what happens to it next.

If ours is, indeed, a wasteful society, it is so for a variety of structural reasons. In arguing that categories of waste and rubbish are made and reproduced in ways that have to do with the social, political and economic ordering of society, we bring a new perspective to bear on practices such as recycling. Rather than seeing these as expressions of personal environmental commitment, we focus again on the systems of provision (including provision of waste management) involved and on the categories and classifications that these entail.

Insights and implications

In the UK, up to 10 per cent of average weekly household expenditure goes on fuel and power (King, 1997). Despite this, and despite the environmental importance of the utilities, efforts to define and analyse sustainable consumption persistently fail to conceptualize the sorts of issues involved. Contemporary theories of consumption have serious limitations when applied to such inconspicuous subjects as energy, waste and water (Shove and Warde, 2001). A recent review of literature on sustainable consumption produced for the UK's Sustainable Development Commission (Jackson and Michaelis, 2003) illustrates this point. This report aims to 'provide an overview of the extensive literatures on consumer behaviour and lifestyle change' (Jackson and Michaelis, 2003, p4). It takes stock of different accounts of 'true' and 'false' needs and examines the 'pathology' of consumerism. It highlights the symbolic role of goods and their importance for identity, for group belonging and for providing meaning in our lives. Still searching for explanations as to why we consume as we do, the authors consider the possibility that 'evolutionary forces have conditioned us to continually strive to position ourselves in relation to the opposite sex and with respect to our sexual competitors', and that consumption has become an integral part of such positioning (Jackson and Michaelis, 2003, p29).

While the report acknowledges that much everyday consumption is invisible, both to us and to our sexual competitors, it has little to say that is of value in trying to conceptualize the dynamics of energy and water consumption and waste generation. These are simply not areas in which acquisition and status run together, in which the pursuit of novelty is a driving force in its own right or in which symbolic markers and signs of social differentiation, let alone sexual competition, are much in evidence.

In this chapter, we have identified some of the distinctive features of energy and water consumption and of waste management. Unlike most other consumer goods, energy and water are important not in their own right, but for the services they make possible. In this context, an adequate theory of sustainable consumption has to account for the ways in which resource use is modulated and mediated by social practice and by the tools and technologies involved along the way. Developing this idea, we conclude that it makes better sense to concentrate not on consumption as such, but on the development, transformation and reproduction of practices, the successful accomplishment of which require the use of certain amounts of energy and water or which result

in the production of certain forms of 'waste'. Although households are often only dimly aware of the resources they use, and although few know much about the social and technical infrastructures of supply, we argue that patterns of consumption are intimately related to the systems of provision involved. In contrast to literatures of the kind referred to above, we pay close attention to the relation between production and consumption and to the manner in which they are interdependent.

Although sometimes useful, the two-part language of consumption and production can also be misleading. In the following chapters we show how crucial environmental resources are filtered through multiple systems of provision and mediated by social and technical infrastructures in ways that are of defining importance for the specification and transformation of demand.

3

Infrastructural Change and Sustainable Consumption

The extent to which technologies define the practices of consumers and structure systems of provision is not immediately obvious, especially in the context of recent infrastructural fragmentation and flux. When viewed alongside the rather static, stable and undifferentiated technical networks of provision that consumers have become accustomed to, it becomes apparent that new combinations of power stations, distribution networks, landfill sites, bins, pylons, transformers, reservoirs and tanks create significantly different contexts for consumption. In this chapter, we reflect upon the changing relations between consumers and infrastructures and upon new combinations of technologies and practice currently redefining the meaning of service provision.

The role that technologies play in structuring possibilities for consumption and in defining demand has been the subject of lively debate. Technological infrastructures have been portrayed as both constraints (Bauman, 1990) as well as facilitators of everyday life and domestic consumption (Otnes, 1988). Sociologists of technology have further emphasized the part that utilities play in configuring technologies and, hence, in shaping the intensity with which resources are used (Cowan, 1983; Forty, 1986; Bijker, 1995). Although grids, conceptualized as highly integrated physical networks and nodes, can denote stability or – put negatively – inertia, they do change over time and in ways that can significantly redefine relations between utilities and users.

In this chapter, we examine the role of technologies and large technological systems in shaping consumption. This serves to show how technologies, utilities and users are jointly implicated in constructing opportunities for sustainable service provision and the management of demand. Taking concepts of consumption and demand to be the products of certain social and technical contexts, we identify five modes of utility network organization – autonomous, piecemeal, integrated, universal and marketized – each representing moments in European

infrastructure management. Different modes of organization are described with reference to examples from the UK and The Netherlands to show how these create and reproduce distinctive contexts for supply-and-demand management.

Turning our attention to recent utility transformations, we reflect upon patterns of infrastructural change connected to privatization and liberalization and upon what these mean for utility and user relations and associated models of demand management. Infrastructural reorganization can take many forms. Patterns of integration and fragmentation have a powerful influence on consumer choice and demand management opportunities. As well as describing some of the processes through which grids and consumer relations are being reformed, we isolate key aspects of environmental renewal that are especially relevant to the restructuring of consumer and provider relations.

Modes of network organization and contexts for consumption

In this section we briefly describe five different modes of network organization and their underlying models of demand. Each mode is illustrated with reference to particular organizational arrangements found at different moments in the development of British and Dutch networks. The modes we describe are not straightforwardly associated with moments in the chronological evolution of utility systems. Different modes can co-exist at the same time in different situations or contexts, but with varying degrees of relative significance.

Autonomous modes of organization

Before water was contained and pooled in large-scale reservoirs and made available through regional distribution networks, consumers had to draw upon local resources, including wells, rivers and lakes. Similarly, before the advent of central collection-and-disposal systems, householders had to find ways of dealing with their waste – one approach in the UK being to burn this on domestic fires and spread the resulting ash on fields or gardens. These systems represent early forms of self-management in which the role of provider and consumer is united. This mode of organization revolves around a model of demand management in which self-providers meet their own needs. Although utility networks are generally configured to provide for a much wider

variety of needs, there are still some households who generate their own electricity, treat their own water or compost their own waste on site.

Piecemeal modes of organization

Like the 'autonomous' mode described above, piecemeal systems are built around localized supplies. A key difference is that independent suppliers are involved in providing services to a somewhat extended customer base. Typical of this mode are the electricity systems developed by private companies and municipalities during the early 1900s in the UK and The Netherlands. These initially incorporated small generating sets designed to provide lighting services to limited numbers of commercial and domestic consumers in urban centres (Hannah, 1979; Bläser, 1992). Hughes (1983) describes how these arrangements developed within UK cities as more and more private entrepreneurs and municipal authorities constructed their own local supply grids and extended their areas of operation with little external regulation or centralized control. According to Graham and Marvin (1995), these networks can also be conceived of as 'islands', in the sense that they are small, locally based and internally focused with a high level of technical, social and economic variability between cities and regions.

While 'autonomous' modes require consumers to act as the co-managers of demand, 'piecemeal' systems shift the balance of control toward the provider. Piecemeal networks are based on the assumption that utility providers (be they private companies or municipal authorities) can meet maximum anticipated demand. This mode is underpinned by a logic that supports the building of supply capacity to meet peak demand. Methods chosen to manage demand under piecemeal arrangements reflect the specific priorities of local suppliers. This means that systems are likely to be developed and managed in rather ad hoc or uncoordinated ways that contribute to the development of a high proportion of idle 'capacity'. There are, again, contemporary parallels. For example, some local authorities now generate and distribute electricity to their tenants and build systems that run alongside the main grid (Gosling, 1996; Hodgson, 1997).

Integrated modes of organization

This mode is characterized by a more 'integrated' approach to network management in which 'spare' capacity is viewed as productive 'space' that needs to be exploited. In respect of electricity, both Forty (1986) and Hughes (1983) have argued that the concept of 'load factor' is

critical in explaining the development of more integrated forms of network management. Load factor refers to the ratio of the amount of electricity supplied during a specified period to the amount of electricity it would have been possible to supply at maximum output during that period. For many electricity managers, load factor has become the key indicator of technical or commercial efficiency, a view founded on the notion that commercial and operational benefits are best achieved through regularity of load and the maximum practical utilization of generating capacity (Hughes, 1983). This has led many suppliers to consider how they might attract new loads and diversify their customer base.

Moves toward network integration are associated with economic imperatives and political priorities. For example, following World War I, the UK government contended that fragmented technical and institutional structures constrained national economic growth and social development and so set about developing a programme of regional consolidation (Hannah, 1979). An important feature of these more integrated regional arrangements was the centralized coordination and management of loads. Newly appointed load dispatchers were assigned the role of matching power station output to the demand of the population they served. Demand management activities were essentially defined in terms of achieving an acceptable load factor on the assumption that optimal efficiency meant maximizing the utilization of network capacity as a whole. We now consider modes of organization characterized by an even greater degree of centralized coordination and control.

Universal modes of organization

Graham and Marvin (1995) suggest that the consolidation of utility networks is symbiotically linked to a Fordist post-war political economy of mass production, mass distribution and mass consumption. This expansionary approach is perhaps best illustrated in the case of the UK electricity network where a post-war social and political climate of 'nation-building', coupled with an unusually harsh winter in 1947, contributed to the creation of an institutional culture in which electricity load planners and forecasters came to regard demand not as something to be differentiated, promoted or controlled, but as a non-negotiable need that had to be met. Such expansionary approaches dominated electricity (and water) management in both the UK and The Netherlands from the 1950s up to the 1970s, a period during which national and regional forecasters and planners continually revised estimates of

demand growth upwards, and in which grids were incrementally extended and interconnected (Patterson, 1990; Tellegen et al, 1996). The need to cater for future demand justified the construction of an extensive network of power stations, reservoirs, overhead lines, underground cables and aqueducts. This also meant that demand had to be generated in order to sustain these systems of mass production.

Marketized modes of organization

As early as the 1940s UK government economists began to have a more influential role in the development of utility networks and markets (Hannah, 1982; Sheail, 1991; Berrie, 1992). In contrast to engineers and planners, these actors had quite different ideas about how networks might be organized and managed. Instead of building extra capacity they suggested that increasing electricity supply was not necessary for the health of the national economy or population and that, in theory, certain demands could be managed or curbed without any detrimental effects. Subsequent decades have seen a burgeoning interest in the economics of the demand side. The privatization of public service monopolies across the UK and The Netherlands reflects just such a marketized approach. The associated restructuring of generation, distribution and supply networks has inevitably had a significant influence on how demand is coordinated and managed nationally and regionally. Guy et al (1997) suggest that privatized utilities have developed a closer interest in the operational efficiency of their networks and in the differentiated demands of their consumers. In essence, demand is viewed not in terms of aggregated needs that have to be met by extending network capacity. Instead, demand is understood as a complex of highly differentiated loads that can be managed or manipulated through market mechanisms.

In autonomous modes of organization, consumers themselves are responsible for defining service expectations and for deciding how resources might be allocated to meet needs. In 'piecemeal' arrangements, local suppliers are guided by the political, economic and geographical feasibility of connecting customers to networks in their designated 'patches'. Universal and integrated modes of network organization and operation are defined more by the social and political priorities of commercial companies, national and regional governments and regulators.

Infrastructural arrangements associated with each mode of organization determine where the boundaries between consumers and producers lie. Autonomous modes consist of stand-alone grids, with

Table 3.1 *Modes of organization and contexts for consumption*

Mode of organization	*Autonomous*	*Piecemeal*	*Integrated*	*Universal*	*Marketed*
Representation of consumer–provider roles	Co-providers of highly localized resources	Customers and suppliers of newly created services	Consumers and promoters of diversified demand	Passive beneficiaries and public providers of uniform services	Purchasers and promoters of differentiated products and services
Supporting infrastructural arrangements	Stand-alone self-managed grids at local scale	Patchwork of local grids providing unregulated and non-standardized services	Semi-integrated grids connecting 'compatible' loads at local and regional scale	Highly integrated national and regional 'super grids' delivering uniform resources	Partially fragmented grids matching the socially and economically defined needs of diverse utilities and users
Representation of consumption	Personal and collective need to be negotiated and managed in-house	Customer defined need to be met	Diverse needs to be nurtured, coordinated and combined	Universal and non-negotiable need to be met	Highly negotiable needs to be manipulated and managed
Model of demand management	Responsive and reflexive	Manufacture and meet	Diversify and develop	Predict and provide	Monitor and manipulate

households involved in the allocation of locally available resources as and when required. By contrast, universal networks now built around extensive, even international, 'super grids' are designed to meet extreme peaks and are built on the assumption that consumers' needs are there to be met.

Each mode revolves around a distinctive representation of consumers' roles in provision and in managing demand. Consumers sometimes figure as competent self-managers of mini-networks, and sometimes as passive customers whose non-negotiable needs must be met by public institutions and infrastructures. Alternatively, they might be positioned as rational economic actors with specific service requirements. Demand is variously regarded as something to be nurtured and manufactured, to be curbed and controlled, to be manipulated and managed or to be met at all costs. In short, Table 3.1 suggests that consumer roles and demand are social and technical constructs in so far as they reflect the priorities of different constellations of actors operating in divergent political and institutional contexts.

In isolating these modes of organization and what they mean for consumption and demand management we also make the point that multiple possibilities for the sustainable reconfiguration of networks co-exist. Even so, some modes support methods of managing demand that obviate the need for others. In this sense certain consumer or demand cultures can become 'locked in', guiding network development along certain paths and preventing the switch to alternative management regimes. For example, the universalizing post-war culture of electricity organization in the UK supported the building of more and more capacity and its interconnection through the national grid. This effectively limited opportunities for other forms of demand management.

So far, we have provided a static analysis of different types of infrastructural arrangement. In the following sections we explore ways of conceptualizing socio-technical change and the relation between different modes of organization.

UNDERSTANDING INFRASTRUCTURAL CHANGE AND TRANSITION

Hughes (1983) argues that manufacturers, utilities and regulating bodies all have vested interests in the growth and durability of particular systems. As large technical systems develop, key actors form alliances

and act to protect or promote their own system against competition from others. As a consequence, technological systems reinforce themselves internally by becoming increasingly standardized and gathering 'momentum' (Hughes, 1983) or dynamic inertia (Joerges, 1988). From this perspective, technical systems not only embody the ideals, values or technological frames of the context in which they evolve, but also develop a dynamic of their own. For example, Hughes (1983) describes how the concept of 'universal' electricity supply gathered momentum during the 1890s as a supportive culture and context developed, and has since evolved into a 'super-system' with mass movement and direction.

The concept of technological 'momentum' is useful in understanding the capacity of current actors to reconfigure technologies and so implant new social and environmental contexts for the management of demand. Arguments about the momentum of technologies and technological systems are also relevant in thinking about how today's consumers might become locked into certain ways of thinking about demand and into certain modes of demand management. For example, the idea that 'demand' is something that simply has to be met has clearly influenced the options available to consumers until recently. This has implications for how conceptualizations of demand as something to be curbed or contained might be ingrained or embedded within new systems of utility management.

On the other hand, large technological systems are not closed to reinterpretation and their direction is not always irreversible. The relationship between embedded infrastructural arrangements and organizational change has been extensively analysed in the literature on innovation (David, 1985; Arthur, 1989; Berkhout, 2002).

Proponents of 'technological transition management' view infrastructural change as a multidimensional process that takes place across a number of 'levels' (Kemp et al, 1998; Geels and Kemp, 2000; Elzen et al, 2004). The basic idea is that innovations take root in relatively protected 'niches'. As they become established, so they change the configuration of the 'regime' into which (and within which) they emerge. The development of alternative technologies (for example, solar panels for electricity generation, rain water devices to collect and store water for household purposes and composting bins for domestic waste treatment) is potentially important for the continuity and/or transformation of entire socio-technological regimes (De Laat, 1996). For instance, the introduction of water-saving technologies such as vacuum toilets might require changes in consumers' routines and habits. Such a development also implies meso- or macro-level change in so far as the producers of conventional toilets and managers of sewerage systems

have to find ways of accommodating new technologies and practices within existing networks.

Theories of 'transition' offer a useful way of conceptualizing change on multiple levels and of representing infrastructure system development as a process through which actors continually adapt to, and learn from, new situations (Rotmans et al, 2001). Such multi-level models of change show that there are a variety of routes possible, each moving at different speeds and each exhibiting different degrees of path dependency, lock-in and irreversibility.

Although transition theories provide useful models of sustainable transformation in utility systems, the narratives of change they offer require further scrutiny at the empirical level. The development of 'greener' networks is not always initiated by 'niche' projects, or by small-scale 'bottom-up' developments. In some situations radical changes in the organization of infrastructure networks have been initiated by the promotion of technologies by 'mainstream' actors operating at a large-scale. The introduction of mobile phones and their impact on communication networks is a classic example. The introduction and promotion of air conditioners by utilities and manufacturers and their impacts on indoor climate systems and electricity networks is another (Cooper, 1998). Clearly, there are some technological developments that do not follow the idealized 'S-curve' as implied in transition management. More important for our purposes is the point that consumers' roles in initiating technological transitions across micro, meso and macro levels are not elaborated. These require further empirical investigation.

It is clear from the above that provision and consumption are being restructured from 'niche' through to 'landscape'. Those who restrict themselves to studying the role of the end-consumer only will consequently fail to capture or comprehend the sorts of transformations currently underway. What is required and what this book aims to provide is a multilayered analysis of consumer involvement in sustainable transition through systems of energy, water and waste provision.

INFRASTRUCTURAL DYNAMICS AND NEW CONTEXTS FOR CONSUMPTION

Over the last decade there have been considerable organizational changes in the utility sectors, connected to the privatization programme, market liberalization and environmental modernization that all mark a

redefinition of consumer roles in utility provision (Spaargaren, 1997; Spaargaren and Van Vliet, 2000; Graham and Marvin, 2001). Graham and Marvin (2001) argue that changing commercial, social and environmental pressures have supported the institutional and technical 'unbundling' of infrastructure networks. The concept of 'unbundling' relates to a number of dimensions of institutional and technical change – for example, the fragmentation of physical networks and setting up of new micro-grids; the separation of generation, distribution or supply activities that were previously operated by the same utility company; or the segmentation of networks by market, territory or service category. They further suggest that infrastructures have been 'virtually' segmented – as in situations where competitive service regimes and new operating rules are superimposed over existing organizational structures.

Processes of infrastructure unbundling as described by Graham and Marvin (2001) are expected to reshape the landscape of utility provision, transforming relations between network users and providers and so creating differentiated contexts for environmental and social action. Graham and Marvin (2001) claim that unbundling does not involve the replacement of old modes of organization with new ones. Instead, they describe the development of co-existing pathways operating at different spatial scales and moving at a range of speeds across different utility sectors. These pathways vary in terms of how far they embody different private, public or informal concepts of provision.

In respect of macro-level transformations in the UK and The Netherlands, the pattern is, indeed, one of multiple pathways and directions. In both countries electricity companies have been privatized and markets opened up to competition. Domestic consumers can now choose between service providers and products. The 'de-municipalization' of waste management in both countries has seen waste collection and disposal taken over by private-sector waste management companies. Municipal waste managers now bid for service contracts alongside private-sector competitors with day-to-day operations carried out by a wide spectrum of organizations, including public, private and non-profit organizations (Gandy, 1994). This picture is further complicated by the increasing popularity of home composting and recycling, with some households managing parts of their own waste cycles. While macro transformations in the Dutch and British electricity and waste sectors have followed similar trajectories, water supply routes have diverged. Water companies in the UK have been privatized since 1989. In The Netherlands, after much debate, proposals for privatization have been rejected (Tweede Kamer, 1999; Eerste Kamer, 2003). However, in both countries water supply organizations have been encouraged to

develop public- and private-sector alliances in order to improve economic and environmental efficiency (NRA, 1994; Vewin, 2001).

Although the general trend is assumed to be one of a shift from a 'universal' mode of provision, the reality is a more complex situation in which private and public priorities coexist and in which networks are *both* converging globally and fragmenting locally. For the purposes of analysis, the elements and dimensions of restructuring need to be further broken down if their implications for engendering new contexts for sustainable consumption are to be understood. In the following sections we identify principal forms of network reorganization that are contributing to the greening of grids and service regimes at different levels and scales across Europe. We further reflect upon how these new network arrangements are likely to shape the capacities of different utilities and users in a variety of contexts and situations to act as the environmental managers of networks.

Differentiation of services

Increased competition in utility markets is associated with the introduction of new opportunities for the specialization and customization of utility services. Multiple providers (including local authorities, housing associations and energy service companies) can now serve customers traditionally bound to the services provided by monopoly utility companies. These new arrangements offer possibilities for consumers to choose between service providers and the packages of products or tariffs they offer. Some new service providers might have a real interest in promoting greener services – for example, where they hope to initiate niche markets for environmental goods or services or where access to localized resources is limited and efficiencies can be achieved by minimizing rather than meeting demand (Guy and Marvin, 1996). What is not clear is how the new service possibilities being created and promoted will reframe the contexts within which different types of consumers can and cannot make environmental choices.

Fragmentation of grids

In other cases the environmental renewal of networks is being facilitated through the construction of mini- or micro-grids. Analyses of infrastructural change suggest that the development of more flexible and decentralized technologies and the introduction of competition offer opportunities to develop multiple scales of organization so that consumers can become the local providers of some of their own service

needs (von Meier, 1994; Moss, 2000; Van Vliet, 2002). It is argued, for instance, that low-cost and higher-efficiency decentralized technologies, such as combined heat and power or solar energy units, have created opportunities for more flexible production regimes that better match supply to demand (Künneke, 1999; Awerbuch, 2003). Arguments about the environmental benefits of 'bottom-up' or 'top-down' modes of provision or 'soft' and 'hard' paths of network development are now well rehearsed (Schumacher, 1973; Lovins, 1977; Patterson, 1990). A question that has only been partially addressed is how new, multiply configured scales of organization create diverse contexts for the sustainable management of electricity, water and waste by domestic consumers.

Autonomous systems of technology and practice

The extent to which new 'eco-home' developments allow consumers to achieve 'autonomy' from centralized technical and institutional arrangements varies widely (Barton, 1998). The initiators of many sustainable housing projects believe that it is impossible to be properly 'environmental' without some such detachment. Technologically, this is likely to involve installing renewable generation units or recycling a certain amount of water and/or waste. In practice, such initiatives are of social and symbolic as well as material significance. In exploring these arrangements we focus on the ways in which new modes of provision challenge service regimes and mainstream approaches to demand management.

New models of demand management

Privatization and the elevation of environmental concerns have prompted interest in more integrated approaches to supply-and-demand management. Whereas utility network management has previously been defined by meeting demand through supply-side investment, new arrangements have signalled a renewed interest in the efficiency of utility systems through production, distribution, supply, use and disposal. In particular, privatization has signalled the emergence of demand-side management (DSM) – an approach in which utility managers seek to engage users as the co-managers of demand (Gellings, 1996). Fundamental to the emergence of DSM has been the development of a regulatory framework that challenges engineering-based approaches to utility planning and supply management and reintroduces questions of environmental quality and economic efficiency. The extent to which

these modes of network management incorporate different consumer and provider concepts of efficiency, security or reliability remains to be seen.

Table 3.2 summarizes these four types of utility-related environmental renewal, the forms of socio-technical change they imply and what this is likely to mean for the reconstruction of consumer roles in provision. Cases of environmental innovation associated with each type of infrastructural renewal are also noted.

The four themes of service differentiation, fragmentation of scales, socio-technical autonomy and demand-side management capture the principal processes through which utility and user responsibilities for sustainable provision are being defined and realized. These generic themes can be used to understand environmentally induced socio-technical change with respect to all of the resources and systems with which we deal.

Taking each in turn, Chapter 4 considers how environmentally inspired options for service differentiation – including the introduction of green tariffs and the promotion of recycling schemes – reflect the capacities of consumers and providers to generate, promote and construct new service expectations and needs. The cases of environmental renewal reviewed in Chapter 5 show how meanings of efficiency and optimal performance differ with scale. Chapter 6 considers the range of technologies and practices adopted by households who have deliberately sought to limit their dependence upon mainstream systems of provision. Finally, Chapter 7 focuses on recent efforts by water, electricity and waste utilities to enrol consumers as the co-managers of demand.

In focusing on the four aspects of environmental renewal highlighted in Table 3.2, we draw out details about the sustainable transformation of networks at micro, meso and macro levels of organization and through multiple modes and scales of provision. We further show how the dynamics and directions of infrastructural change relate to the interfacing of old and new constellations of institutional rules and technological structures.

Table 3.2 *Types of environmental renewal in utility systems*

Themes	*Service differentiation*	*Scales of provision*	*Autonomous networks*	*Demand-side management*
Processes and implications of socio-technical change	Multiple products and services and improved choice	Increased technical and institutional fragmentation and new modes of access	Mainstream disconnection and local reintegration of technologies and practices	Reconnection of supply-demand management and improved efficiency
Roles of consumers	Co-constructers of service options and choices	Co-producers of renewable resources	Initiators and self-managers of new grids and service regimes	Co-managers of systems of provision
Illustrative cases	Green electricity Waste recycling Grey water	Photovoltaic cells Local water systems Composting	Eco-homes	Storage systems Efficiency devices