



3. Sustainable consumption in history: ideas, resources and practices

Heather Chappells and Frank Trentmann

A chapter on the history of sustainable consumption might be expected to be very short, if not impossible. After all, history has been a record of increasingly unsustainable forms of life. People started to clear land and extract resources in Southern China and the Near East 12000 years ago. Irrigation and rice cultivation already started to raise methane levels some 5000 years ago. Whichever indicator we choose, the human pressure on the earth has grown exponentially, especially since the eighteenth century. The world's population grew more than sixfold between 1700 and 2000. The proportion of land devoted to cropland catapulted, from 2 per cent to 11 per cent; pasture grew even faster from 2 per cent to 24 per cent. The industrial revolution, which started in Britain in the late eighteenth century, intensified coal consumption and mineral extraction. In the twentieth century, synthetic nitrogen started to overtake the natural nitrogen cycle. Global water use increased fivefold. The extinction of species accelerated, as did the amount of carbon in the atmosphere, especially since the 1950s. Notwithstanding greater efficiency, material flows continue to rise per capita as well as in total; the only periods which saw a short-lived pause were the end of the Second World War and the collapse of the Soviet Union. Today, people carry a greater material rucksack on their back than at any other time in history (Klein Goldewijk 2010; Krausmann et al. 2009; Ruddiman 2005; Steffen et al. 2004).

Looking at these trends, it is tempting to see the present concern with 'sustainable development' as a healthy break with a catastrophic past. Instead of looking at past failures, where one generation after another ate into the future of the next, should we not look forward to a brighter future where the economy is once again in equilibrium with the environment and development is sustainable, meeting 'the needs of the present without compromising the ability of future generations to meet their own needs', in the famous words of the landmark report by the United Nations World Commission on Environment and Development, the Brundtland Commission, in 1987 (WCED 1987)?

To look forward without looking back, however, would be a mistake. This chapter highlights three ways in which history can add useful perspectives on sustainable consumption today and tomorrow. The first contribution of historical research is to uncover the evolution of the idea of sustainability itself. Experts who turned their focus on sustainable consumption in the 1980s and 1990s did not arrive out of nowhere. Visions of the future – such as plans for 2020 and 2050 – have a history, as do the methods and assumptions on which they are based. Where did these intellectual traditions come from? The second contribution is a greater appreciation of diversity, in terms of groups and regions. In today's discussions, a good deal of data is global and aggregated. This reflects the centrality of global warming. But even within the same society – indeed, even in the same city or district – people have led more or less sustainable lives. Attention to these

different trajectories can shed light on the potential of pathways to sustainability today and the flexibility and stickiness of the practices that consume resources. Finally, history can tell us about the changing resilience of human communities in the face of shortages, disruption and transitions from one resource to another.

3.1 THE IDEA OF SUSTAINABILITY

Thinking about sustainability is not new. People have always had to consider how their activities might influence the future availability of forests, water, crops and other resources. For many agrarian communities managing the commons was a matter of everyday life. It also came to attract the attention of states and administrators. Venice, for example, passed conservation laws in the fifteenth century to prevent short-term deforestation and ensure sufficient timber for its fleet in the future. It was in 1713 that the term ‘sustainable’ made its first appearance, appropriately in the writings of the Saxon forestry and mining official Carl von Carlowitz (1645–1714). In his *Sylvicultura oeconomica* (1713) he offered a guide to sustainable forest management. At the time, Europe was gripped by fears of a ‘wood famine’, partly stoked by governments and landowners trying to limit the customary use of woodlands by the poor. Chopping down trees for short-term interests, von Carlowitz feared, put the future wealth and development of Saxony at risk: the local silver mines would run out of wood and charcoal. He recommended that wood be conserved and planted in such a way that it would enable a ‘steady and sustainable [*nachhaltende*]’ yield and use (von Carlowitz 1713, p. 105). The very survival of the country depended on it; future generations, he wrote, had a right to food and subsistence. A ‘common interest’ (*gemeines Wesen*) was at stake. He singled out three sets of measures: greater efficiency in consumption (such as energy-saving ovens); planned cultivation of saplings and trees; and a search for substitutes (such as peat).

Carlowitz’s book became a set text for administrators in eighteenth-century Central Europe. Forests were measured, evaluated and taxed. As forest science advanced, the adjective evolved into a subject: ‘sustainability’ or *Nachhaltigkeit*. By the early nineteenth century, the French had ‘*production soutenu*’, the Americans ‘sustained yield forestry’ (Grober 2002). In England, John Evelyn had already tackled the wood crisis in his *Sylva* in the 1660s, but here the urgency over wood receded as the country turned to coal.

The idea of sustainability gained clarity from a shift in knowledge about the soil. In the sixteenth century soil, like the body, was understood via the theory of the humours. Health resulted from the right balance between different elements. This way of looking at the land meant problems could be rectified by short-term rebalancing, not long-term management. It was in the eighteenth century that attention shifted from balance to recycling nutrients via the injection of fresh manure into a field to restore fertility for a future harvest (Warde 2011).

Empire, war and population growth made the eighteenth century an early laboratory for exploring the limits to growth, especially in regions with marginal lands and limited resources and food supply. Botanists and agronomists saw their mission as being to extract the treasures of the different climes that a providential God had created for the ingenuity of man to discover. Barren lands contained untapped value. The question

was: how much value and by what means it could best be extracted? The late eighteenth century saw a major debate over the potential of the Scottish Highlands, where it was increasingly hard to sustain a growing population. On one side were liberal-minded reformers who blamed bad policy, not nature. Once evil laws like the salt and coal duties were lifted, backward Highland communities would develop into vibrant commercial societies, fishing and trading; ‘excess’ population, however, would still have to emigrate. On the other side were those who looked to the state, not the market, for development. Instead of spending on overseas colonies, where Highlanders could emigrate to, they argued that it would be much better to promote internal colonization. State-sponsored canals, peat extraction and model villages would support the population in their homeland. Tobacco and sugar beet could be grown in the Hebrides and the British army would be able to retain its Highlanders known for their war-like spirit. The Highlands (and Britain), in this view, needed hands-on state intervention not the ‘invisible hand’ of markets (Albritton Jonsson 2013).

The clash between market and state solutions mirrored contrasting views of nature. For liberal enlightenment thinkers like Adam Smith, nature and markets were broadly self-correcting: extremes balanced each other out. Natural historians were more pessimistic: nature was vulnerable, easily disturbed and needed careful management. From the 1790s, the mood was turning darker. Food crises gave ‘limits’ a new urgency. The big ‘improvement’ projects, like the Caledonian Canal, turned out to be expensive flops. Above all, fear of another shortage took hold: a coal famine. In 1789, John Williams revealed that he had been unable to find any coal reserves in Scotland. Even worse, he warned, Britain had managed to burn through half the coal ever mined in the country in the last 80 years alone. At that rate, coal would soon be exhausted and ‘future inhabitants of this island must live, like its first inhabitants, by fishing and hunting’ (Williams 1789, quoted in Albritton Jonsson 2013, p. 174). His answer was to stop coal exports and develop seams in Canada.

These episodes were milestones in the idea of sustainability. They shed light on several features. First, it is misleading to view modern history in terms of sequential phases, where unchecked industrialization gave way to an incipient new paradigm of sustainability. Rather, the concept of sustainability emerged in the heat of economic development and industrialization. Second, and related, it was the resource crises of development (the wood crisis, the coal famine) that focused contemporaries’ minds on how to cultivate and conserve for the future. Sustainability is not some prelapsarian state: it is a crisis concept. And it is these crises that produced the science of measuring resource depletion, such as Williams’s calculations of coal exhaustion. Third, limits to growth prompted ideological debate and different policy proposals. These operated with different geographic scales. Materials flows could be managed ‘internally’ by cultivating and conserving resources within a particular region or kingdom, or ‘externally’ by drawing on distant lands. In this sense, sustainability was not politically innocent, but tied to larger political battles over empire, markets and nation.

In these early developments, we can find ideas that parallel the current language of sustainable development: balancing economic life with nature and responsibility for the well-being of future generations. But we should not use history only to find ourselves in the past. History also reveals what is lost and different. Unlike today, all the authors mentioned above approached the question of limits from a regional perspective, not

a shared global environment; Vernadsky introduced the ‘biosphere’ in the 1920s, but plural ‘environments’ only became a single global ‘environment’ after the Second World War (Robin et al. 2013). Williams’s answer to the anticipated coal shortage was to mine coal in Nova Scotia, not to switch to renewable energies. Nor was sustainability an overarching goal. After all, Carlowitz wanted to conserve wood in order to extract and smelt more minerals. Finally, we need to note the significance of religious beliefs and emotional aesthetics in the call for sustainable use. As Carlowitz and generations of ‘improvers’ appreciated, human activity had consequences for future generations, but ultimately the world moved according to Divine time. Centuries were followed by eternity. Nature carried God’s footprint, not just that of humans. It was always more than an economic unit: a store of divine beauty. For Carlowitz, trees were ‘unspeakably beautiful’. In sum, the space of sustainability has widened to encompass the whole globe but narrowed in terms of its religious and cultural associations and temporal horizon (Mauch 2013, pp. 22–30, 48–56).

Material shortages and fears about future developments in the nineteenth and twentieth centuries – such as the efficiency movement of the years around 1900 and in the era of the two world wars – rang in new rounds in the battle between optimists and pessimists. Did the answer lie with greater efficiency or had natural limits been reached that required restraints on consumption and population growth? The debate reached a new height of alarm in the years of rapid growth after the Second World War. In 1955, the American conservationist Samuel Ordway warned that growth had become a dangerous religion and the world was approaching ‘the limit of growth’. As resources were running short, costs would rise. He called for a new ‘ethic for an age of conservation’ (Ordway 1956). The establishment of the Club of Rome in 1968, with its mission to study the ‘world problematique’, strengthened the idea that the world faced an array of interconnected environmental and social problems. Its report on the *Limits to Growth* (Meadows et al. 1972) used computers to present future scenarios and model the interaction between accelerating industrialization, rapid world population growth, widespread malnutrition and poverty, dependence on non-renewable resources and their depletion, and a deteriorating environment. What made the Meadows report so influential was that it both defined and measured sustainable development in terms of achieving balance between the economy, the need to maintain finite environmental resources and an improvement of social well-being.

The Brundtland Report in 1987 (WCED 1987) made sustainable development the organizing principle of transnational environmental policy. Concerns about resource allocation and material efficiency did not disappear but they were now recast in the economic language of natural capital stocks. The historian Emma Rothschild has stressed how Brundtland was widely interpreted as an injunction to ‘maintain environmental capital intact’ (Rothschild 2011, p. 194). At an institutional and policy level, this interpretation favoured the quantification of natural resources in national, regional and global environmental accounting systems. Human or social capital were also accounted for, but as Rothschild notes, this excluded many factors that added to well-being but did not have a measurable market value (Rothschild 2011). It was universalist and presentist, ignoring that cultures might value nature for different reasons, and that future generations might not share our yardsticks. It should be noted, though, that proponents of ‘ecosystem services’ continued to include the support of diverse cultures and aesthetic

beauty and creativity among the list of nature's benefits upon which societies depended (Daily 1997).

The UN Conference on Environment and Development in Rio de Janeiro in 1992 operationalized the Brundtland approach and, by doing so, gave consumption greater visibility. Concrete initiatives and goals set out principles of economic, environmental and social sustainability for governance systems and consumer practice. The global, national and local sustainability action plan known as Agenda 21 dedicated a chapter to 'changing consumption patterns' (United Nations 1993). It emphasized the need to manage excessive demands and unsustainable lifestyles among richer societies. Excessive resource use in industrialized regions had to be redistributed to meet basic needs in poorer parts of the world. A more equitable rebalancing of resources at a global scale had thus been added to older concerns with regional sustainability.

Rio's Agenda 21 also gave greater attention to material flows. It called for an assessment of environmental impacts and resource requirements through the full life cycle of products and processes. This more fluid approach was reiterated at the Oslo Symposium on Sustainable Consumption two years later (Norwegian Ministry of the Environment 1994) and was formalized as a focus for national and global sustainability policy through the United Nations Environment Programme (UNEP) Sustainable Consumption and Production (SCP) Framework, to be implemented through the Marrakech Process (UNEP 2012). A fundamental objective of the increasingly influential SCP approach was to decouple economic growth from environmental degradation: nations could deliver more goods and services with less impact in terms of resource use, environmental degradation, waste and pollution (UNEP 2012). The vision of green growth marked a break with ideas that aligned sustainability with conservation and thrift.

SCP was founded on a resource-based, economicistic approach which quantified the resource impacts of consumption and calculated the savings from more efficient technologies and processes. The objective was to reduce the material intensity of both production and consumer lifestyles by some measurable factor (Noorman and Uiterkamp 1998; von Weizsäcker et al. 1998). Agenda 21 and subsequent SCP policies looked to a multipronged strategy to manage demand via improved end-user and supply chain efficiencies, reducing wastage and limiting the use of finite resources in the production and consumption process. Market and voluntary instruments included eco-labelling, green tariffs, smart metering and environmental taxes. These would provide consumers and producers with signals about the environmental impact of their behaviours across the entire product chain. The Organisation for Economic Co-operation and Development (OECD)'s *Towards Sustainable Household Consumption?* saw the decisions of individual households as the main drivers of consumption and assumed that they would make the right pro-environmental choices given the right information and inducements (OECD 2002).

The career of the SCP paradigm was strangely at odds with the flourishing interest in consumption in the social sciences and humanities since the 1970s. While SCP policies approached consumption in individualistic terms of rational economic choice, sociologists, anthropologists and historians asked about status and distinction, meanings and communication, systems of provision, power and identity, and social practices (Bourdieu 1984; Brewer and Trentmann 2006; Miller 1998; Schama 1987; Shove 2003). In particular, SCP failed to take into account the structured and habitual nature of the many social

practices that were responsible for the bulk of unsustainable forms of consumption, such as driving, bathing and showering, and cooling and heating (Shove 2003; Southerton et al. 2004; Warde and Gronow 2001; Welch and Warde, Chapter 5 in this book).

Today, it is widely acknowledged that the voluntary and market-based tools favoured by SCP have had little effect in reducing intensity of material consumption and curbing unsustainable lifestyles or their global spread. In absolute terms, the global consumption of resources has continued to increase (OECD 2013). The limited achievements of global sustainable consumption policies have prompted a call to view consumption not only in economic terms but also through a social lens (UNEP 2012, p. 16). The gulf between the SCP approach and research in the social sciences has narrowed in recent years, although it certainly has not been bridged.

Looking at sustainable consumption through a social lens challenged the foundations of resource-based policy narratives. It highlighted the fact that people do not primarily consume resources, but the services they make possible. Shove's case studies showed how people did not value energy or water in themselves but for the services they provided: comfort, cleanliness and convenience (Shove 2003). This way of thinking also opened up a new perspective on the role of technologies in organizing consumption. In Agenda 21, technologies had been seen as tools for promoting eco-efficiency and curbing unsustainable behaviours. By contrast, historians of technology and socio-technical theorists used the concept of scripts, the idea that a vision of the world can be inscribed in the content of a technical object and shape how it is used (Akrich 1992), to explain how domestic appliances and devices structured unsustainable consumption. Infrastructure networks were also seen to embody the ideas of institutions about the efficient allocation and management of resources. Given the sunk costs of incumbent networks these notions could become locked in, making managers reluctant to explore sustainable alternatives (Arthur 1994). These studies challenged the more optimistic faith in consumer agency to make greener choices (Spaargaren and van Vliet 2000; van Vliet et al. 2005).

Contemporary sustainability policies acknowledge that solutions need to be tailored to local contexts, but they focus primarily on common environmental goals. Such a focus can ignore the diversity of cultural pathways to sustainability. The recent interest in alternative consumption in France, for example, has had little to do with the global project of promoting 'sustainable consumption'. The adoption of a 35-hour week and the revival of anti-consumerist movements were part of a social and political turn to 'discriminating consumerism', not driven by environmental directives (Sanches 2005).

3.2 RISING LEVELS OF CONSUMPTION

One way in which historians used to approach the growth of consumption was with the idea that eighteenth-century Britain gave birth to a 'consumer society' (McKendrick 1982). According to this idea, the eighteenth century amounted to a sharp break, after which the desire for and acquisition of goods took off. Hanoverian Britain appeared as a precursor of the 'take-off' model of economic development held out by W. Rostow and other champions of modernization during the Cold War. We now know that societies in Renaissance Italy (fifteenth century) and late Ming China (sixteenth–seventeenth

centuries) had their own cultures of consumption and acquired a growing number of goods (Brook 1998; Clunas 1991; Welch 2005). So what changed? One change concerned a shift in orientation from public to private life. Renaissance town palaces did indeed fill up with more furniture and household objects, but consumption remained oriented towards public display and magnificence. Since then public consumption has not entirely disappeared, but in the course of modern history goods and services have increasingly assumed private meanings and functions. A second shift has been about flow and direction. A good deal of consumption in Renaissance Florence was circular: goods were borrowed, inherited, pawned and circled back and forth between families. Late Ming and early Qing China prized antiquity over novelty. Again, such circular flows have not entirely disappeared, but relatively they have been pushed aside by through-flow, that is, an accelerating injection of new stuff, a good deal of which is then discarded and disposed of.

From the seventeenth century onwards, with Holland and England in the lead, the movement has pretty much been in one direction: upward. English inventories document the rapid increase in mirrors, furniture, curtains, teapots, cutlery and much else in the years around 1700 (Weatherill 1996). Social, economic and cultural factors were at work: a cult of novelty (such as cotton textiles with vibrant colours and designs); an interest in exotic spices and drinks (cocoa, tea, coffee, sugar); the growing significance of ‘comfort’ and sociability which required and showcased consumer goods (the upholstered chair, curtains, tea parties); urbanization, which enhanced the significance of goods and fashions for communication and identity; and an appreciation of things for personal development, economic growth and national strength. While they never completely went away, earlier suspicions of luxury now faced serious defenders of ‘modest’ luxury in Enlightenment thinkers like David Hume and Adam Smith. The precocious embrace of things in Britain and Holland was favoured by comparatively open markets and competition that facilitated a transition from household self-provisioning to buying and selling goods in the market place. Elsewhere in Europe, by contrast, guilds and Church courts continued to discriminate against outside traders and punish their own womenfolk for buying fashionable clothes and trying to earn their own money (Ogilvie 2010).

The global advance of consumption was helped by empires, states and social movements; and this is important to stress, as many discussions of sustainability today focus on individual households as if they were the natural and only agents to consider. In the nineteenth century, European empires and missionary groups exported new lifestyles based on comfort and cleanliness. Western cities launched major infrastructure projects that delivered water, gas and electricity. In early twentieth-century Japan, housewives’ associations worked together with state officials and architects to promote Western kitchens, fashions and lifestyles over traditional customs. At the same time and across the West, buyers’ leagues were asserting the right and power of consumers as citizens. In liberal societies, growth, choice and a higher standard of living were attractive instruments to defuse class conflict. But fascism and Stalinism, too, promised their followers a future of material comfort. The acceleration in material flows and consumer goods since the 1950s needs to be located on this longer upward trajectory (Trentmann 2012).

In the following pages, we look at three domains that have particular bearing on sustainability, to illustrate some of the historical dynamics of consumption: water, energy and waste.

3.2.1 Water Pressure

The history of changing water use illustrates how consumer practices came to be unsustainable and how they might be changed. The provision of clean, piped and constant water has been one of the central achievements of modern cities. This story has been mainly told from the perspective of engineering, infrastructures and supply. Yet, to understand the dynamics of demand, it is also necessary to look at the consumer's perspective. Water shows how what is considered 'normal' use is elastic. Whereas in the context of water sellers or communal wells, an inhabitant had once made do with 5 gallons a day, the arrival of piped supply suddenly led to the consumption of many more units. In Newark, USA, water consumption shot up from 20 gallons a day per person in 1870 to 113 gallons in 1898. In Atlanta, USA, it even reached a phenomenal 225 gallons or 885 litres per person per day in 1884. By contrast, people in European cities made do with 17 gallons (Berlin) and 44 gallons (London) in this period. In the 1880s, many American cities thus faced a serious sustainability challenge. The response was to impose meters. By 1888, Atlanta had managed to push consumption below the watermark of 100 gallons per capita per day. Metering also spread in European cities, with one significant exception: Britain. Here liberal political culture was opposed to a blanket intervention by the state in private life. Political ideas and institutions thus shaped the setting of consumer behaviour (Fuentes 1906; Grahn 1902; Royal Commission on Water Supply 1900).

One push in consumption's upward trajectory came from class-based ideals of 'civilized' practices, such as bathing. Once treated as an exceptional luxury and charged as such on a special rate by water companies, a bath became redefined as a 'need' from the middle of the nineteenth century. Instead of paying the water companies a higher special rate, middle-class citizens formed consumer defence leagues to fight for the new standard of a cheap, regular bath.

The shift from water pumped during certain hours to constant supply and ready availability 'on tap', day and night, further transformed habits, expectations and domestic technologies. When London introduced constant supply in the 1880s, landlords and public health reformers joined forces to eliminate 'dirty' cisterns in working-class districts. Such storage containers had been sources of resilience in the past. When London was hit by a series of harsh winters, which cracked pipes, and a European-wide drought in the 1890s, that resilience was gone. Consumers did not tolerate a return to limited hourly supply. Instead, they now left the taps on all day to make sure their tubs and containers would fill up while they were out. They also mobilized against the water companies, arguing that, far from a natural calamity, the drought was the man-made result of the profit hunger of private monopolies. The companies, in turn, accused consumers of criminal 'waste' and causing a water famine by taking advantage of constant supply not for 'normal' consumption but for watering gardens and even supplying ponds. Investigations revealed how much consumption was not the result of conscious individual choice, but caused by bad fittings and leaking taps. In the district of Shoreditch, water consumption was cut by half following the installation of regulated fittings. In 1903, London's water moved into public hands. The social democratic claim was that by giving all citizens a stake in water, inhabitants would behave responsibly, eliminating the risk of shortages in the future. Reality proved otherwise. While baths shrunk in size, per

capita consumption continued to increase as new water-hungry practices spread (such as washing the car) and others intensified (more frequent baths and, later, showering) (Shove 2003; Taylor and Trentmann 2011; Taylor et al. 2009).

The global pattern of water use in the twentieth century was one of continuous climb overall, but some periods stand out for escalating demand. Global freshwater withdrawals grew most rapidly in the 1950s and 1960s. Culture, climate and shifting infrastructures and living arrangements help to explain why dependence on water intensified during this time. In Britain and Europe, it was during this period that internal baths and flushing toilets arrived in most people's homes. In Australia, most families by the 1960s were also able to turn a tap to obtain a copious supply of hot water, a convenience that came with more frequent and extravagant national bathing practices (Davison 2008). Yet how Australian families used water inside their homes paled beside their extravagant use outside. Melbourne water authorities calculated that the average consumption of water increased in the course of the 1970s by 15 per cent inside the house, but by 52 per cent outside. The main factors were rapid suburbanization and the transformation of the back garden, changes that were also visible elsewhere in the rich world. Once a utilitarian space for growing food, storing fuel and hanging up the laundry, the back garden became a place for leisure and socializing (Davison 2008). The metamorphosis involved extensive irrigation of lawns and flowerbeds, and the filling of swimming pools. It is these practices that became the focal point for discussions of excess use during subsequent water crises.

Over the last century, water management has broadly followed two distinct logics, each with its own understanding of network resilience and sustainability. From 1900 to the late 1970s, most consumers in the developed world paid a negligible price for water and received a steady supply via big public engineering projects (Duarte et al. 2011). Few efforts were devoted to conservation during this era of unlimited entitlement. From the mid-1970s, by contrast, water ceased to be considered cheap and abundant as infrastructures became ever costlier and environmental externalities received greater attention. A new paradigm emerged which looked to demand-side management and water saving. In reality, this paradigm shift was neither smooth, nor complete.

Twentieth-century droughts in advanced consumer societies such as Britain are instructive for how perspectives changed about what consumption is considered wasteful and what indispensable. Disruptions also illustrate the shifting balance between consumer and provider responsibilities for sustainable resource management. Experiences of drought in the post-1945 period challenged the idea that more supply and bigger infrastructures would solve rising demand (Taylor et al. 2009). During the 1959 drought, engineers and economists accused consumers of undervaluing water and treating it as infinite. Calls for water to be valued as an economic good became a recurrent theme in this and subsequent resource crises. Drought management methods have focused on regulating 'wasteful' consumption. Usually this meant voluntary appeals urging citizens to curb non-essential water uses, primarily to stop watering their gardens and washing their cars. Occasionally it meant restrictions. In the 1976 drought, national water authorities introduced water rationing and patrols to enforce hosepipe bans in some areas in order to protect supplies for big industrial consumers. Hosepipe bans for domestic consumers were again widespread in 1995 and 2006. Droughts also challenged what practices and purposes of water use should be treated as essential. In 2006

a swimming pool and hot tub could be filled with water, but it was not permitted to use a hosepipe to wash a private car or water a domestic garden. Droughts also showed the significance of people's hobbies, routines and values for how they adapted. Those who valued gardens for socialization or cultivation, for example, were more likely than others to use a watering can, even if this took considerable time and effort (Medd and Chappells 2008).

Rather than a clean shift from supply to demand management, however, British droughts point to an ongoing and evolving mix of provider and consumer responsibilities for sustainability. Thus in 1976 standpipes for consumers were complemented by measures to stretch the supply system to its limits by 'flogging the rivers and reservoirs' (Morren 1980). The 1990s looked for savings from greater efficiency, such as reducing the excessive 'demand' caused by leaking pipes. As in the 1890s, issues of provider responsibilities and of consumer rights continued to bubble up. In Yorkshire in 1995, some metered customers resisted water-saving measures in response to high water bills and distribution network leakage, which worsened the supply situation. Tankers were ultimately used to bring water into some villages. In 2006, greater environmental awareness supported a more integrated view of resilience where engaging consumers in demand management during the drought was seen as a way to pre-empt the need for supply-led adaptations, such as bulk transfers from other regions (Defra 2008). In turn, drought strategies today have started to concern themselves with long-term cultural adaptation as well as the short-term restrictions of the past (Environment Agency 2008). Instead of treating demand as the aggregate of a statistical average consumer, there is renewed interest in cultural change and in the diverse conditions, technologies and values that shape people's consumption (Medd and Chappells 2008).

The portion of the global population affected by chronic water shortages has expanded rapidly from around 9 per cent in 1960 to 35 per cent in 2005 (Kummu et al. 2010). As demand exceeds supply in more and more regions of the world, sustainability appears less and less achievable (Pacific Institute 2009). What adaptation approaches will drought-stricken regions come to embrace, and what visions of sustainable consumption will inform these? The case of California offers one illustration of how adaptations have been made in a region facing chronic shortage. California's historical struggles with drought exemplify the resulting distributional challenges resulting from Americans' migration to hotter, drier regions in the twentieth century; the dream of California living drew 35 million new residents to the state in the course of the twentieth century (Brown 1999). The current drought (2013–2014) has prompted mandatory restrictions on lawn watering for some residents in addition to long-term approaches to supply-side resilience. Recycled municipal wastewater has become a significant source of water for golf course and landscape irrigation, and for drinking through groundwater replenishment. In such responses to chronic water shortage we see the re-emergence of a heroic engineering logic, but one that is now linked to conservation and reuse that are part of late twentieth-century principles. Water managers see the Carlsbad Desalination Project in San Diego County, the largest seawater desalination plant in the Western Hemisphere, as another solution to California's water woes. Ironically, this response to producing a resilient and stable water supply is not so sustainable in terms of energy consumption; desalination plants use about 30 per cent more energy than other current water supply options.

3.2.2 Energy

In Europe, total energy consumption increased sevenfold between 1870 and 2000. In per capita terms, three times as much energy was consumed at the end of the twentieth century as at the end of the nineteenth. The rise was most dramatic during the years of the post-war boom until the oil crises, from 1950 to 1973. Since then energy consumption has been uncoupled from economic growth, thanks to a major reduction in energy intensity. The aggregate trend is one of convergence; in 1870 per capita consumption in France and Spain was still only a quarter of that in Britain, today it is roughly the same. There has been a broad shift towards 'cleaner' fuels (such as gas) and cleaner electricity consumption. Britain, once the first industrial nation and the world's worst carbon emitter, has seen a decline in carbon emissions from energy since the 1970s, helped by deindustrialization. In general, the slight decrease in carbon emissions since the mid-1970s has come from a fall in energy intensity rather than decarbonization (Kander et al. 2013). There has been an overall rise in standards of heating and cooling comfort. In British homes, for example, insulation and central heating (mainly gas, and thus more sustainable than previous heating fuels) has facilitated a reduction in energy consumption even while average internal temperature in winter rose from 11 to 17 degrees Celsius between 1970 and 2010 (DECC 2013). American homes are now often cooler during the summer than in the winter, due to a reliance on air-conditioning. In 1955 fewer than 2 per cent of American households had air conditioning (Biddle 2008). In 2009, 87 per cent of US households were equipped with air conditioning (US EIA 2011). Such dramatic shifts resulted from a mix of factors: some about the ideal home as a place of security, comfort and family harmony, fostered by television and advertisers; others involving active policy support, such as when in 1957 the Federal Housing Administration began to include air conditioning as part of the mortgage cost (Cooper 1998).

Still, aggregate trends and averages can easily hide the significant diversity of energy consumption and the different habits, technologies, lifestyles and values that drive it. A few examples illustrate the persistence of diversity within affluent societies. In 1974 the German energy giant RWE surveyed use patterns in one neighbourhood. It found that 11 per cent of residents bathed several times a day, but 17 per cent only once a week. Half the residents cooked a warm lunch and dinner, 42 per cent cooked lunch only and ate cold cuts in the evening (RWE 1975). In Britain, at the time of writing in 2014, every tenth household lives in fuel poverty. Meanwhile, one in five households has a conservatory, most of which are heated. The richest 10 per cent of households consume more than four times as much gas as the bottom 20 per cent (DECC 2013, p. 60). Diversity extends to the shifting demands made by energy-hungry practices. British data shows that cooking draws half the energy today that it did in 1970. By contrast, electrical appliances have been using more and more: 5 per cent of household energy in 1970, 14 per cent in 2000 (DECC 2013). Alongside cookers and freezers (the big users of energy), homes have been invaded by hordes of new appliances and gadgets, a trend already discernible before the arrival of personal computing and electronic media. In the United States, there were 10 million aquariums in 1992. One in five homes had a waterbed. Some Americans used electric piano warmers. Transformers multiplied; in California in the early 2000s, 13 per cent of all residential energy went for standby or sleep mode (ACEEE 2000; Meier et al. 1992).

For interwar America it is sometimes said that the diffusion of appliances was prompted by the declining price of electricity (Kander et al. 2013, p. 317). But this has limited explanatory power for other periods. In Britain, in fact, the price of electricity has been rising since 1970 but appliances have proliferated nonetheless. To explain this we need to appreciate a basic point about the dynamics of consumption. Resources and fuels are a means for an end: they enable people to accomplish certain tasks and enjoy particular services, but these have their own logics and histories, relatively autonomous from the price of energy (about which most people know surprisingly little). The decline in home cooking, for example, has resulted from the rise of eating out in contemporary culture. At the same time, kitchens have evolved from badly lit sites of food preparation into bright and shiny places for socializing, with an unprecedented number of light fixtures. Compared to industry, households in Western countries have overall had a disappointing record when it comes to energy saving. To understand this we need to look at the changing meanings and functions of what people do, as well as at prices and regulation. The distinct trajectory of energy consumption in California holds some clues.

For the past 40 years, per capita residential electricity consumption has remained nearly constant in California while growing by 75 per cent in the rest of the United States. Geography and demography help to explain part of the divergence. California's mild climate means that heating and cooling demand has not increased as much as in other states, while the number of people per household has remained higher than elsewhere (Levinson 2013). Another reason, however, is California's progressive regulatory approach to energy efficiency. California's reaction to the 1973 oil crisis was distinctive. Growing population, environmental concerns and rapidly escalating costs for nuclear power plants made energy regulators turn towards consumers and demand-side management to cope with short supply. Energy saving was presented as a substitute power plant. Efficiency measures were conceived of in terms of 'negawatts' (Lovins 1989). Since the 1970s, a series of energy efficiency interventions, including building codes, helped to slow the growth of Californian residential demand. Negawatts were cheaper in most periods than megawatts from finite fossil fuels or nuclear power plants. As the cost of natural gas fell during the 1990s, the focus on efficiency waned. But interest in demand-side management was rekindled by the electricity supply crisis of 2000–2001 and growing concern about long-term energy and environmental problems (Lutzenhiser 2010; Lutzenhiser et al. 2004). Californian households increasingly embraced voluntary conservation, continuing beyond the immediate crisis (Lutzenhiser et al. 2003).

Prior to 2000, California's demand-side programmes were mainly geared towards promoting efficiency not conservation with customers stimulated to reduce energy use while maintaining comparable levels of heating, cooling and lighting. This view started to change during the 2001 crisis as a call for conservation was met with collective altruism (Kunkle et al. 2004); for example, 6 per cent of households reported using no air conditioning at all and almost half took other conservation actions related to cooling or heating.

What will happen if consumers in China and India aspire to the same comfort standards as European or American societies? Energy consumption in residential buildings has increased markedly in China since 1990, helped by rapid growth and urbanization. Across Asia, air conditioning use has surged. By 1998, 70 per cent of urban households in Shanghai owned air conditioners. The demand for cooling energy is predicted to rise

by up to 50 per cent by 2100 for Asia as a whole, driven by income growth, population increase, rapid urbanization, increases in house size and, paradoxically, climate change itself (Isaac and van Vuuren 2009). Initiatives to regulate cooling practices, however, may make a dent in this soaring demand. Some Chinese cities have adopted regulations that prohibit residents from setting thermostats below 26°C during the summertime. The oft-cited Cool Biz campaign in Japan combines similar thermostat rules and clothing policies to limit air conditioning demand in government offices.

The shift towards more energy-intensive ways of achieving comfort has been contributing to the intensity and experience of energy crises. Power cuts in Italy and France during the summer of 2003 were associated with a growing reliance on air conditioning (Trentmann 2009). In India, too, it has led to an increase in blackouts (Wilhite 2008). Across the world, many energy grids are at or close to their capacity at times of peak demand, creating significant problems for long-term resilience, health and security as well as for ecological sustainability.

Resilience in relation to managing future resource shortages will depend on an appreciation of diversity in consumer practice and in engaging consumers in keeping demand in balance with supply. The response to the California energy crisis of 2001 and to the drought in England in 2006 point to the possible role consumers might play in the future, with conservation and efficiency becoming a way of life.

3.2.3 Waste

Consumption puts pressure on sustainability as new goods and resources are acquired and put to use. But equally important is a later stage: when, where and how goods are disposed of. What happens to the value remaining in disposed goods is a major issue for sustainability, since the reuse of materials and their reintegration into the economy could reduce the pressure on untapped virgin resources. How has the expansion of consumption affected the dynamics and value of waste?

The last century and a half saw three revolutions in waste in the developed West. The first, in the late nineteenth century, introduced municipal waste management. From New York to Berlin, city authorities took over the collection of household waste and marginalized rag pickers. Solid waste was separated from human waste, which increasingly was flushed away into sewers rather than returned to the soil. This phase combined incineration and landfill with sorting at the household level and with the municipal separation of valuable material such as glass, metal and swill (for pigs) (Melosi 1981). A second phase, from the 1920s, made landfill ('controlled tipping') the preferred solution; by the 1960s, it handled 90 per cent of household waste in Britain and the United States, and 70 per cent in France and Germany. The 1970s ushered in a third phase: a turn away from landfill and a revival of recycling and of using waste for generating heat and energy. These were overlapping phases, not distinct waste regimes. It is worth recalling that as late as the early 1950s, New York City collected 600 tonnes of swill a day for pigs. Nor did all regions follow the same pattern. In the 1950s, Holland operated big sites that turned urban waste into compost. Shanghai mixed burning and burying waste with sending human excrement to neighbouring farms into the 1980s (Goldstein 2012). At the point of writing in 2014, rich societies continue to show considerable diversity, in terms of both how much waste they generate and how they treat it. In 2010, Germany

and Belgium recycled 60 per cent of their municipal waste, while in Portugal and Greece it was a mere 20 per cent. Still, these phases give a sense of overall direction.

It is more problematic to draw a simple correlation between the growing amount of waste and a throwaway mentality. Earlier societies were not pure, austere communities where nothing of value was thrown out (Rathje and Murphy 1992). The Mayans and the Romans did it. Archaeologists have found barely chipped porcelain thrown out by colonial Americans in the eighteenth century. Reuse there was, but we should not romanticize it. Nor did materials flow only in locally integrated cycles. In the nineteenth century, textiles were pulped to produce paper, but such resources did not flow back to where they had been extracted. Clothing that had been made from Indian and Egyptian cotton ended up in newspapers and books in London and New York. Early municipal sorting machines in American cities found that households were throwing away a lot of bottles, metals and other valuable materials in 1900.

What changed in the twentieth century was not only the volume but also the composition of waste, its value and systems of regulation. Ash declined (as households shifted from heating with coal to gas and electricity), paper and (from the 1960s) plastics increased. Technological innovation disrupted processes of recycling in two main spheres. Thanks to the Haber–Bosch process, synthetic nitrogen eliminated the need for natural nitrogen from animal and human waste in farming. In paper-making, sulphites shifted processing from textile rags to wood pulp. Recycling campaigns continued in wartime drives for greater self-sufficiency as well as in years in peacetime when the price for material was rising. In Europe more so than in the more affluent United States, thrift, reuse and the experience of wartime salvage drives left a legacy after 1945; in Holland, for example, the women who pioneered recycling bins in the 1970s had been shaped by these earlier experiences (Oldenziel and Weber 2013). In many ways the problem was not that people during the affluent 1950s–1960s no longer cared about the destiny of their used glass and paper; there were many voluntary or Church-led collections in these years in Britain as well as on the Continent. Rather, prices for used materials were falling to such a low level that mountains of newspapers were piling up in church halls, unwanted by manufacturers. Still, even in those years, it is important to recognize that in some branches – such as steel or copper in the United States – industries had extensive recycling loops. Faced with chronic shortages, socialist countries developed impressive recycling networks and mobilized populations to show socialism's edge over wasteful capitalism. In reality, socialist waste management magnified the inefficiencies of the system, and in some areas (such as the collection of old car tyres in Hungary), developments went backwards in the course of the 1960s–1980s (Gille 2007).

In Western consumer societies, the 1970s–1980s ushered in a third phase, which looked to recycling. Environmental movements and the rising price of energy and materials initiated the shift but, arguably, it might have faded away in the long run as in earlier price cycles, if it had not been for national governments and, later, the European Community which introduced regulatory and price mechanisms that supported recycling and punished landfill; material recovery legislation and new waste laws were introduced by Japan (1970), Germany (1972) and Sweden (1975), and crowned by the European Landfill Directive in 1999. Demand for materials from China's rapidly growing economy and the liberalization of the European waste and recycling trade has helped, too. The integration of the European market in 1993 saw a major increase in the movement of

waste and its reuse within Europe; the bulk of hazardous waste stays within Europe, although illegal shipments of e-waste to Africa continue to be a serious source of pollution and death (EEA 2013).

Recycling, however, has had paradoxical results. In Europe, bottle banks facilitated the triumph of the one-way bottle, although in Japan sake bottles are still reused 20 times. In Europe and the United States, household waste continued to expand from the 1970s to the early 2000s. In 2010, the average French person threw out four times as much as in 1970. In the EU-15, packaging waste alone increased by 10 million tonnes between 1997 and 2004. Food waste shows how these volumes are the result of social and technological factors: more fragmented meal times, the demands of conflicting schedules and social practices, refrigeration and over provisioning, and a fixation with expiry dates and ‘freshness’. To blame a lack of individual morals is simplistic; in fact, most people feel bad when throwing wilted lettuce or other edible foods into the bin (Evans 2012).

In Europe, household waste has fallen slightly since 2008 but this may be the effect of the global recession rather than a long-term change in material use. The one exception to this trend has been Japan, which managed to reduce waste in the 1970s with the help of an integrated system of government regulation, neighbourhood civil activism and surveillance, education, fines and commercial recyclers (European Environment Agency 2013; Itoh 2004; OECD 2013). In general what recycling has done is to make waste manageable. It has not led people to reduce their use of materials – the priority of the famed EU waste pyramid. Diversion from landfill has so far not translated into zero waste, that is, the recovery of enough materials from waste to make up for the wood, energy and water that would be used otherwise. Even the most progressive anti-waste city, San Francisco, only manages to recover half its waste; in Stockholm it is not even a quarter (Zaman and Lehmann 2013).

Throwing things away is not the only form of disposal, however. The centrality of other forms – from charitable and second-hand gifting to storage and collecting – urges us to be cautious when today’s consumers are being reprimanded for having become wasteful, uncaring and indifferent to things. Anthropologists in Tucson (Arizona) found that when households replaced goods, only 6 per cent were actually thrown away; the majority was given or sold to family and friends, the rest handed to charity or stored at home (Gould and Schiffer 1981). In a major survey, the US Environmental Protection Agency (EPA) found that some 70 million computers and 104 million TV sets sit unused in lofts and garages (EPA 2011). Self-storage has mushroomed across the West in recent decades. Arguably, the problem is not that consumers are too profligate but that they are reluctant to let go of their stuff and allow rare metals and materials to find their way back into the cycle of production.

3.3 OUTLOOK

Sustainable consumption remains an emerging field in the study of history, notwithstanding the considerable advances in environmental history (McNeil 2001; Worster 1993). This chapter has highlighted the evolution of the concept and the interplay between practices, politics and networks that have shaped responses to shortages and crises in distinct historical contexts. There are two dimensions in particular which would benefit

from more attention by future historians of consumption. The first is the interaction between households, firms and states. In the course of the twentieth century, the study of consumption became fixated with the private end-user. But a lot of resource use and consumption of course happens in firms and public places or, at least, is made possible by them, such as public leisure, hospitals, company canteens, housing and welfare benefits. In crises over water and energy, the demand of private consumers stands in tension with those of big industrial consumers. How these are negotiated and reconciled in different historical contexts, and with what consequences for sustainability, is a worthy field of inquiry. Secondly, our understanding of energy transitions and shifts in other resources has mainly proceeded from the contribution of technologies, networks and supply. We know surprisingly little about the role of households and how their habits and attitudes influenced the course of such transitions. Households are mainly treated as passive recipients of changes initiated elsewhere, a position that is at odds with the celebration of the active and creative consumer in the field of consumption more generally. We know, from the difficulties faced by champions of clean cooking stoves in the developing world, how important the culture of cooking and everyday life more generally is for the adoption of new technologies. How did households in the past respond to earlier transitions?

ACKNOWLEDGEMENTS

We gratefully acknowledge support from the Arts and Humanities Research Council (AHRC), AH/K006088/1; the Dynamics of Energy, Mobility and Demand (DEMAND) centre (Engineering and Physical Sciences Research Council/ Economic and Social Research Council, EPSRC/ESRC); and (Frank Trentmann) the Leverhulme Trust for an International Fellowship.

REFERENCES

- ACEEE (American Council for an Energy-Efficient Economy) (2000), *Proceedings of the 2000 ACEEE Summer Study on Energy Efficiency in Buildings*, August, Washington, DC: American Council for an Energy-Efficient Economy.
- Akrich, M. (1992), 'The de-scription of technical objects', in Wiebe Bijker and John Law (eds), *Shaping Technology/ Building Society*, Cambridge, MA: MIT Press, pp. 205–224.
- Albritton Jonsson, F. (2013), *Enlightenment's Frontier: The Scottish Highlands and the Origins of Environmentalism*, New Haven, CT: Yale University Press.
- Arthur, W.B. (1994), *Increasing Returns and Path Dependence in the Economy*, Ann Arbor, MI: University of Michigan Press.
- Biddle, J. (2008), 'Explaining the spread of residential air conditioning, 1955–1980', *Explorations in Economic History*, 45 (4), 402–423.
- Bourdieu, P. (1984), *Distinction: A Social Critique of Judgment and Taste*, London: Routledge.
- Brewer, J. and F. Trentmann (2006), *Consuming Cultures, Global Perspectives: Historical Trajectories, Transnational Exchanges*, London: Bloomsbury Academic.
- Brook, T. (1998), *The Confusions of Pleasure: Commerce and Culture in Ming China*, Berkeley, CA: University of California Press.
- Brown, T.C. (1999), 'Past and future freshwater use in the United States: a technical document supporting the 2000 USDA Forest Service RPA Assessment', General Technical Report RMRS-GTR-39, Fort Collins, CO: USDA.
- von Carlowitz, H.C. (1713), *Sylvicultura oeconomica, oder haußwirthliche Nachricht und Naturmäßige Anweisung zur wilden Baum-Zucht*, Leipzig: Braun.

- Clunas, C. (1991), *Superfluous Things: Material Culture and Social Status in Early Modern China*, Honolulu, HI: University of Hawaii Press.
- Cooper, G. (1998), *Air Conditioning America: Engineers and the Controlled Environment, 1900–1960*, Baltimore, MD: Johns Hopkins University Press.
- Daily, G.C. (ed.) (1997), *Nature's Services: Societal Dependence on Natural Ecosystems*, Washington, DC: Island Press.
- Davison, G. (2008), 'Down the gurgler: historical influences on Australian domestic water consumption', in Patrick Troy (ed.), *Troubled Waters: Confronting the Water Crises in Australia's Cities*, Canberra: ANU Press, pp. 37–65.
- DECC (Department of Energy and Climate Change) (2013), *United Kingdom Housing Energy Fact File: 2013*, London: Department of Energy and Climate Change.
- Defra (Department for Environment, Food and Rural Affairs) (2008), 'Future water: the government's water strategy for England', London: Department for Environment, Food and Rural Affairs.
- Duarte, R., V. Pinilla and A. Serrano (2011), 'Looking backward to look forward: water use and economic growth from a long-term perspective', No 1104, Documentos de Trabajo (DT-AEHE), Asociación Española de Historia Económica, available at <http://econpapers.repec.org/paper/ahedtaeh/1104.htm> (accessed 12 April 2014).
- EEA (European Environment Agency) (2013), *Managing Municipal Solid Waste: A Review of Achievements in 32 European Countries*, Copenhagen: European Environment Agency.
- Environment Agency (2008), 'International comparisons of domestic per capita consumption', Bristol: Environment Agency.
- EPA (Environmental Protection Agency) (2011), 'Electronics waste management in the United States through 2009', Washington, DC: US Environmental Protection Agency.
- Evans, D. (2012), 'Binning, gifting and recovery: the conduits of disposal in household food consumption', *Environment and Planning D: Society and Space*, 30 (6), 1123–1137.
- Evelyn, J. (1664), *Sylva, or a Discourse of Forest-Trees*.
- Fuertes, J.H. (1906), *Waste of Water in New York and its Reduction by Meters and Inspection*, New York: Merchant's Association of New York.
- Gille, Z. (2007), *From the Cult of Waste to the Trash Heap of History: The Politics of Waste in Socialist and Postsocialist Hungary*, Bloomington, IN: Indiana University Press.
- Goldstein, J. (2012), 'Waste', in Gould, R.A. and M.B. Schiffer (eds) (1981), *Modern Material Culture: The Archaeology of Us*, New York: Academic Press.
- Grahn, E. (ed.) (1902), *Die Städtische Wasserversorgung im Deutschen Reiche sowie in einigen Nachbarländern*, Munich and Leipzig: Oldenbourg.
- Grober, Ulrich (2002), Tiefen Wurzeln: Eine kleine Begriffsgeschichte von 'sustainable development' – Nachhaltigkeit, *Natur und Kultur*, 3 (1), 116–128.
- Isaac, M. and D.P. van Vuuren (2009), 'Modeling global residential sector energy demand for heating and air conditioning in the context of climate change', *Energy Policy*, 37, 507–521.
- Itoh, H. (2004), *Waste Management in Japan*, Southampton: WIT Press.
- Kander, A., P. Malanima and P. Warde (2013), *Power to the People: Energy in Europe over the Last Five Centuries*, Princeton, NJ: Princeton University Press.
- Klein Goldewijk, K. (2010), 'Historical Database of the Environment (HYDE)', PBL Netherlands Environmental Assessment Agency, available at <http://themasites.pbl.nl/tridion/en/themasites/hyde/index.html> (accessed 14 April 2014).
- Krausmann, F., S. Gingrich, N. Eisenmenger, K.H. Erb, H. Haberl and M. Fischer-Kowalski (2009), 'Growth in global materials use, GDP and population during the 20th century', *Ecological Economics*, 68 (10), 2696–2705.
- Kummu, M., P.J. Ward, H. de Moel and O. Varis (2010), 'Is physical water scarcity a new phenomenon? Global assessment of water shortage over the last two millennia', *Environmental Research Letters*, 5 (3), available at <http://iopscience.iop.org/1748-9326/5/3/034006> (accessed 12 April 2014).
- Kunkle, R., L. Lutzenhiser, S. Sawyer and S. Bender (2004), 'New imagery and directions for residential sector energy policies', in *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*, Washington, DC: American Council for an Energy-Efficient Economy, pp. 171–182.
- Levinson, A. (2013), 'California energy efficiency: lessons for the rest of the world, or not?', National Bureau of Economic Research (NBER) Working Paper No. 19123, June, Cambridge, MA: NBER.
- Lovins, A. (1989), 'The Negawatt Revolution – solving the CO₂ problem', Keynote address at the Green Energy Conference, Montreal: Canadian Coalition for Nuclear Responsibility, available at <http://www.ccnr.org/amory.html> (accessed 12 April 2014).
- Lutzenhiser, L. (2010), 'The evolution of energy efficiency policy', in D. Reeve, D.N. Dewees and B. Karney (eds), *Current Affairs: Perspectives on Electricity Policy for Ontario*, Toronto: University of Toronto Press, pp. 158–193.

- Lutzenhiser, L., R. Kunkle, J. Woods and S. Lutzenhiser (2003), 'Conservation behavior by residential consumers during and after the 2000–2001 California energy crisis', in California Energy Commission (ed.), *Public Interest Energy Strategies Report 100-03-012F*, Sacramento, CA: CEC, pp. 146–197.
- Lutzenhiser, L., R. Kunkle, J. Woods, S. Lutzenhiser and S. Bender (2004), 'Lasting impressions: conservation and the 2001 California energy crisis', in *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*, Washington, DC: American Council for an Energy-Efficient Economy, pp. 229–240.
- Mauch, C. (2013), *Mensch und Umwelt: Nachhaltigkeit aus historischer Perspektive*, Munich: Oekom.
- McKendrick, N. (1982), 'The consumer revolution of eighteenth-century England', in N. McKendrick, J. Brewer and J.H. Plumb (eds), *The Birth of a Consumer Society: The Commercialization of Eighteenth-Century England*, Bloomington, IN: Indiana University Press, pp. 9–33.
- McNeil, J.R. (2001), *Something New Under the Sun: An Environmental History of the Twentieth-Century World*, New York: W.W. Norton & Company.
- Meadows, D.H., D.L. Meadows, J. Randers and W.W. Behrens III (1972), *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, New York: Universe Books.
- Medd, W. and H. Chappells (2008), 'Drought and demand in 2006: consumers, water companies and regulators', Final Report to UK Water Industry Research (UKWIR), April, Lancaster: Lancaster University.
- Meier, A., L. Rainer and S. Greenberg (1992), 'Miscellaneous electrical energy use in homes', *Energy*, 17 (5), 509–518.
- Melosi, M. (1981), *Garbage in Cities: Refuse, Reform and the Environment, 1880–1980*, Pittsburgh, PA: University of Pittsburgh Press.
- Miller, D. (ed.) (1998), *Material Cultures: Why Some Things Matter*, London: UCL Press.
- Morren, G. (1980), 'The rural ecology of the British drought of 1975–1976', *Human Ecology*, 8, 33–64.
- Noorman, K.J. and T. Schoot Uiterkamp (eds) (1998), *Green Households? Domestic Consumers, Environment and Sustainability*, London: Earthscan.
- Norwegian Ministry of the Environment (1994), *Report of the Symposium on Sustainable Consumption*, Oslo: Norwegian Ministry of the Environment.
- OECD (Organisation for Economic Co-operation and Development) (2002), *Towards Sustainable Household Consumption? Trends and Policies in OECD Countries*, Paris: Organisation for Economic Co-operation and Development Publishing.
- OECD (Organisation for Economic Co-operation and Development) (2013), *Environment at a Glance: OECD Indicators*, Paris: Organisation for Economic Co-operation and Development.
- Ogilvie, S. (2010), 'Consumption, social capital, and the "industrious revolution" in early modern Germany', *Journal of Economic History*, 70 (2), 287–325.
- Oldenziel, R. and H. Weber (2013), 'Introduction: reconsidering recycling', *Contemporary European History*, 22 (SI: 3), 347–370.
- Ordway, S. (1956), 'Possible limits of raw material consumption', in W.L. Thomas (ed.), *Man's Role in Changing the Face of the Earth*, Chicago, IL: University of Chicago Press, pp. 987–1009.
- Pacific Institute (2009), *Fact Sheet on Water Use in the United States*, Oakland, CA: Pacific Institute.
- Rathje, W. and C. Murphy (1992), *Rubbish: The Archaeology of Garbage*, New York: Harper Collins.
- Robin, L., S. Sörlin and P. Warde (2013), *The Future of Nature: Documents of Global Change*, New Haven, CT: Yale University Press.
- Rothschild, E. (2011), 'Maintaining (environmental) capital intact', *Modern Intellectual History*, 8 (1), 193–212.
- Royal Commission on Water Supply (UK) (1900), 'Final report', 38 (1), [Cd.25].
- Ruddiman, W.F. (2005), *Plows, Plagues and Petroleum: How Humans Took Control of Climate*, Princeton, NJ: Princeton University Press.
- RWE (1975), RWE Archive: Abt. Anwendungstechnik Marketing, June, Bericht ueber die Haushaltkundenbefragung 1974 im direkten RWE-Versorgungsgebiet.
- Sanches, S. (2005), 'Sustainable consumption à la française? Conventional, innovative, and alternative approaches to sustainability and consumption in France', *Sustainability, Science, Practice and Policy*, 1 (1), 43–57.
- Schama, S. (1987), *The Embarrassment of Riches: An Interpretation of Dutch Culture in the Golden Age*, New York: Alfred A. Knopf.
- Shove, E. (2003), *Comfort, Cleanliness and Convenience: The Social Organization of Normality*, Oxford: Berg.
- Southerton, D., H. Chappells and B. van Vliet (eds) (2004), *Sustainable Consumption: The Implications of Changing Infrastructures of Provision*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar.
- Spaargaren, G. and B. van Vliet (2000), 'Lifestyles, consumption and the environment: the ecological modernization of domestic consumption', *Environmental Politics*, 9 (1), 50–76.
- Steffen, W., A. Sanderson, J. Jäger, P.D. Tyson, B. Moore III, P.A. Matson, K. Richardson et al. (2004), *Global Change and the Earth System: A Planet under Pressure*, Heidelberg: Springer.
- Taylor, V., H. Chappells, W. Medd and F. Trentmann (2009), 'Drought is normal: the socio-technical

- evolution of drought and water demand in England and Wales, 1893–2006’, *Journal of Historical Geography*, 35 (3), 568–591.
- Taylor, V. and F. Trentmann (2011), ‘Liquid politics: water and the politics of everyday life in the modern city’, *Past and Present*, 211 (1), 199–241.
- Trentmann, F. (2009), ‘Disruption is normal: blackouts, breakdowns and the elasticity of everyday life’, in E. Shove, F. Trentmann and R. Wilk (eds), *Time, Consumption and Everyday Life*, Oxford: Berg, pp. 67–84.
- Trentmann, F. (2012), *Oxford Handbook of the History of Consumption*, Oxford: Oxford University Press.
- United Nations (1993), *Agenda 21: Earth Summit – The United Nations Programme of Action from Rio*, New York: United Nations.
- UNEP (United Nations Environment Programme) (2012), *Global Outlook on Sustainable Consumption and Production Policies: Taking Action Together*, Paris, United Nations Environment Programme.
- US EIA (US Energy Information Association) (2011), ‘Residential Energy Consumption Survey’, Washington, DC: US Energy Information Association, available at <http://www.eia.gov/consumption/residential/> (accessed 12 April 2014).
- Van Vliet, B., H. Chappells and E. Shove (2005), *Infrastructures of consumption: Environmental Innovation in the Utility Industries*, London: Earthscan.
- von Weizsäcker, E.U., A.B Lovins and L.H. Lovins (1998), *Factor Four: Doubling Wealth, Halving Resource Use – A Report to the Club of Rome*, London: Earthscan.
- Warde, P. (2011), ‘The invention of sustainability’, *Modern Intellectual History*, 8 (1), 153–170.
- Warde, A. and J. Gronow (2001), *Ordinary Consumption*, London: Routledge.
- Weatherhill, L. (1996), *Consumer Behaviour and Material Culture in Britain, 1660–1760*, London: Routledge.
- Welch, E.S. (2005), *Shopping in the Renaissance: Consumer Cultures in Italy, 1400–1600*, New Haven, CT: Yale University Press.
- Wilhite, H.L. (2008), *Consumption and the Transformation of Everyday Life: A View From South India*, New York: Palgrave Macmillan.
- WCED (World Commission on Environment and Development) (1987), *Our Common Future*, Oxford: Oxford University Press.
- Worster, D. (1993), *The Wealth of Nature: Environmental History and the Ecological Imagination*, Oxford: Oxford University Press.
- Zaman, A.U. and S. Lehmann (2013), ‘The zero waste index: a performance measurement systems in a “zero waste city”’, *Journal of Cleaner Production*, 50 (1), 123–132.