**Chapter 2**

# Infrastructures, practices and the dynamics of demand

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**Abstract**

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Mainstream policy and engineering approaches often suppose that consumers' needs for resources such as energy, water or data precede the development of infrastructures, and that the task of governments and firms alike is to predict and provide for these needs. In this chapter we argue that infrastructures, the social practices they sustain, the devices and appliances involved and the patterns of demand that follow are interlinked and that they mutually influence each other. We identify three ideal typical formulations – one in which ever-expanding infrastructures are linked to increasingly demanding practices; one in which infrastructures shrink or change, but sustain and stabilise current practices, and one in which practices and supporting infrastructures are radically reconstituted. We conclude by commenting on the scope for engendering configurations of infrastructures and practices that would be much less carbon-intensive than those with which we are familiar today.

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## Introduction

In this chapter we challenge mainstream policy and engineering approaches which suppose that consumers' needs for resources such as energy, water or data precede the development of infrastructures, and that the task of governments and firms alike is to predict (or uncover) and provide for these needs. Instead, we contend that infrastructures, the social practices they sustain, the devices and appliances involved and the patterns of demand that follow are interlinked and that they mutually influence each other. To give a very simple example, being connected to an electricity grid enables people to engage in a multitude of power-dependent practices and hence supports the reproduction of these practices and the energy they call for, in turn justifying the development, perpetual extension and continuous operation of relevant electricity supply infrastructures. Despite this interweaving, academic and policy discourses routinely split matters of supply and demand apart, treating each as separate sites of enquiry and intervention. Discussions about how to improve efficiency are consequently divorced from an understanding of how practices such as those relating to heating, cleaning, cooking, personal care or communication develop. Similarly, debates regarding the growth of complex networked infrastructures (Hughes, 1983; Mayntz and Hughes, 1988) or of 'post-networked' cities (Coutard and Rutherford, 2013, 2016; Bulkeley et al., 2013) take place aside from parallel theories of consumption and from accounts of how complexes of social practice emerge and disappear (Shove, Pantzar and Watson, 2012). Within science and technology studies, infrastructures remain a core topic of concern, but often with an emphasis on infrastructures in the making or as carriers of social and institutional politics and values (Star, 1999). As a result, there is relatively little analysis, and hence understanding, of exactly how infrastructures, appliances and practices coevolve.

We argue that such analysis is essential for understanding why demands for energy, water or data have historically tended to increase with the development of large networks and how they might decline in the future. In developing such an approach, we describe three ideal-typical configurations: one associated with ever-expanding infrastructures, growing resource consumption and increasingly demanding practices; the second with modified and sometimes shrinking infrastructures that sustain and stabilise current practices, but that do so more efficiently and with fewer resources than before; and the third implying more or less radical changes in practices that entail or that are associated with more or less radical disconnection from some (typically, electricity) but not all (typically, not the internet) infrastructures viewed as being essential to the reproduction of everyday life in old-industrialised Western societies.

We first outline and elaborate upon the proposition that infrastructures and practices mutually shape each other in contingent and variegated ways. We then examine the three ideal-typical configurations and discuss the ways in which infrastructure-practice relations play out in each case. We end by commenting on the scope for engendering arrangements that would be much less carbon-intensive than those with which we are familiar today.

## Conceptualising infrastructural configurations

Our approach is informed by a handful of concepts drawn from social theories of practice and from theories of materiality and of networked systems. We build on four related ideas and observations. First, we argue that, rather than simply meeting pre-existing needs, infrastructures shape relations between practices, material artefacts and related concepts of service (e.g., of comfort, convenience) in time and space; reciprocally, established practices shape and sustain specific infrastructural configurations. Second, we emphasize that infrastructures are multi-purpose: they enable many practices at once. Equally, many practices involve the simultaneous or sequential use of several infrastructures: for example, taking a shower typically requires (usually grid-supplied) energy, piped, pressurised water and a connection to a sewer system (or septic tank). Third, this enabling is always mediated by appliances of one kind or another. For example, people do not 'use' electricity in some raw form. Instead, demand happens when electrically powered devices or material arrangements become integral to the conduct of specific practices. Needs and demands for power or for other resources such as water or data are not abstract: they are formulated in relation to social practices enacted at particular places and times (Shove and Walker, 2014). Fourth, as networks become an essential part of cooking, lighting, computing or heating, etc., the need for reliable supply becomes multiply embedded and increasingly important in daily life (Nye, 2010), giving rise to new forms of network dependence. As a consequence of these four features, infrastructures, appliances and practices coevolve over time.

From this point of view, the extent and timing of *resource consumption* is a consequence of the range of resource-demanding practices: of when, by whom and on what scale they are enacted and the relative efficiency of the devices and appliances involved. As others have observed (including Kline (2000) who studied 'technology and social change in rural America' in the first half of the twentieth century), appliances like freezers, showers and computers have a critical role in mediating between the infrastructures and networked systems of provision that bring power to the socket, water to the tap or data to the port and the ongoing conduct of specific practices.

As Kline (2000) convincingly argues, rural Americans' increased use of electricity was not the result of some spontaneous acknowledgment of the superiority of electricity over other sources of energy. Rather, it was the outcome of an active process of promotion and domestication of electric appliances with many remarkable successes and some spectacular failures in a context in which electricity as a source of energy was, at least initially, highly contested.

The diffusion of network-dependent appliances – that is, appliances using grid electricity, tap water or telephone lines – have helped to foster the emergence, the reproduction and the reinforcement of modern domestic standards of comfort, convenience, cleanliness and communication. To achieve this result, appliances draw power, data and even water and convert them into *services* which become central to the conduct of daily life. This takes different forms. Consider electricity supply. In some cases, the need for grid-supplied power arises from a process of delegation typically from a human (or from human labour) to an appliance. This is, for instance, the case with laundry, many aspects of which are now undertaken by a machine, which, incidentally, also requires pressurised water supply. Many other practices (mowing, drilling, hoovering, trimming one's beard or hair) have come to depend on the use of powered rather than hand-operated devices. Electrification is often, but not always, associated with the provision of additional features – as when telephones become cordless or linked to an answer-phone or when doors are held in place by electronic or electromagnetic locks. In some of these situations, powered variants enable (and reflect) the emergence of new practices. For example, fridges and freezers have had a critical role in transforming systems of food provisioning and feeding/eating practices within and beyond the home (Rees, 2013). In addition, some, but not all, of these practices and appliances have no "unpowered" prehistory. As these various examples suggest, there are significant differences in *how* powered technologies have (re)constituted practices and in *when*, in the life of a practice, this (re)shaping occurs.

As processes of co-development or coevolution of infrastructures and practices take hold, the reliability of supply becomes an important dimension, even a condition, of contemporary *dependence* on networked systems. Indeed, as a system becomes more reliable and taken for granted, additional uses of the system (or the connection of new appliances), often requiring high reliability of supply, are facilitated, hence increasing dependence as people (as practitioners) are bound into certain *infrastructural/technological systems* and into sets of *institutional relations* that surround and constitute the process of 'using' electricity today.

As outlined above, attending to the relation between infrastructures, appliances and practices depends – at a minimum – on paying simultaneous attention to the form of infrastructural provision, the range and design of intermediating appliances, their role in the conduct of different practices and the relation between consumers and relevant institutions and systems of provision. In the rest of the chapter, we use these ideas to structure an account of three infrastructure-practice configurations (summarised in Table 2.1, below). But before going further, and to avoid misunderstanding, we add a cautionary note: in taking this approach, our aim is to distil and describe features of the relation between infrastructure and practice that appear to be relevant and important for a discussion of the emergence, persistence and possible decline of demand. Although we refer to a handful of empirical cases, these have an illustrative role in what is an essentially conceptual, and at times speculative, exercise.[1]

[Table 2.1 here]

**Extending infrastructures: transforming practices and increasing demand for resources**

The historical development of large infrastructure systems in Western societies appears to follow a common pattern of escalating demand, increasing the value of services and/or decreasing unit costs of provision. The details vary, reflecting the specific combination of economies of scale, scope and club inherent to the network technologies deployed, but the prevailing idea is that infrastructures develop to meet pre-existing needs. This is at odds with the fact that those involved in making 'big' networks and systems of water, power or communications are also actively involved in building demand on a correspondingly massive scale. As writers like Forty (1986) or Kline (2000) have shown, the need for electricity or other networked technologies does not exist in the abstract, nor is consumption simply determined by availability, accessibility and affordability. Rather, it is an outcome of complex processes of demand-making and reciprocal influence between supply and demand, in which network-connected appliances and devices become available, accessible, affordable, desirable and then embedded in multiple social practices and hence in the conduct of daily life.

Strategies like those of predict and provide – in which planners anticipate future 'need' and build capacity capable of meeting it – have acted as self-fulfilling prophecies: generating the very forms of demand to which investments and infrastructures are allegedly a response. The history of energy supply and of related domestic appliances provides ample evidence of this, as illustrated in the following examples.

Consider, first, the early development of the domestic use of gas in Paris from the late 1880s (see Chatzis and Coutard (2005) for a more detailed account). In less than two decades, the proportion of Parisian dwellings equipped with gas supplies jumped from barely 5% in 1888 to two thirds in 1905 (Berlanstein, 1991: 52). The main driving force behind this massive expansion of gas supply was the competitive threat created by the development of electricity. After the first experiments with electrical street lighting in Paris, the same very rich Parisians and the same trendy department stores that had promoted gas lighting over oil lamps turned to electricity. The Parisian Gas Company (PGC) management was soon convinced that its future rested on the growth of its domestic market. The PGC's first major commercial move occurred in 1887: '[That year], the company reached out to the sixty-five thousand apartment dwellers, almost all in luxury buildings, whose residences were near a mounted main. Management did so by offering to install at its expense the internal pipes, a kitchen lighting fixture, and a stove. ... By 1905, 137,000 new customers had accepted the offer of free installation of fixtures. ... Hardly any apartment that rented for more than five hundred francs was without gas' (Berlanstein, 1991: 55-6).

But this first offer, because it was limited to a minority of the population, was not in itself enough to turn gas into a mass consumption commodity. This was to be achieved by the second commercial step taken by PGC:

With the prodding of city hall, the company took the monumental step of democratising gas use in 1894. It created the fee-free program: residents of apartments renting for less than five hundred francs annually would not have to pay for the installation of pipes, the rental of a meter or upkeep of equipment. Eventually, the company even excused them from leaving a deposit. ... Eighty percent of the new customers after 1894 came to the PGC as a result of the policy. Fee-free customers also accounted for 80 percent of the growth in gas consumption after 1895 (Berlanstein, 1991: 56).

Another example of how demand is actively produced is provided by studies of rural electrification in the United States in the inter-war period when networked electricity supply was being developed. In the United States (as in other Western societies), home economists, also known as home electrification specialists, were hired by utility companies and public electrification bodies. These agents were charged with the mission of 'pushing electricity' (Kline, 2000: 178). The progressive engineer Morris Cooke, the architect of the US Rural Electrification Agency (REA), remarked in 1935, as quoted by Kline, that 'our big job is to build up the psychology of the generous use of electricity – a few lights in a home is not rural electrification. ... Really to electrify rural America we must adopt every possible means for building up its use' (2000: 178). In order to promote the use of electricity in activities on the farm, the US Rural Electrification Agency organised a 'Farm Equipment Tour' from 1938 to 1941. The 'REA Circus', as it was informally called, is described by Kline (2000: 181) as the REA's Utilisation Division 'major promotional effort'. In the Tour,

male agricultural engineers demonstrated water pumps, milking machines, milk coolers, feed grinders, ensilage cutters, corn shellers, chicken brooders, soil-heating cables, safe wiring, household plumbing, and such novel devices as a rotating drum with rubber 'fingers' that plucked chicken – a popular attraction. Female home economists demonstrated household lighting, 'efficient' kitchen arrangements, and electric refrigerators, hot plates, rosters, ranges, coffeemakers, washing machines, irons, vacuum cleaners, and radios. They also supervised the lucrative all-electric lunch tent (Kline, 2000: 181).

A third example is provided by Ruth Cowan's (1983) seminal study of household technology. Cowan demonstrates that home electrification had transformative effects – not just by making washing and cleaning 'easier', but by changing the very nature of domestic practices and the conventions and expectations associated with them. In the cases she describes, 'labour saving' technologies co-developed with new, more exacting standards, meaning that although energy demand and the use of electrically powered household equipment increased significantly, the time American women spent on domestic chores did not reduce. In effect, the development of new infrastructures and the diffusion of new appliances helped establish new interpretations of 'normal' comfort and cleanliness. Studies of practices such as Cowan's demonstrate that material elements and technologies are in part constitutive of the practices they enable.

Our last example concerns a later phase in the history of electricity supply. From the 1970s, Électricité de France (EDF), the French national utility, actively promoted electric heating. This campaign was quite directly related to a problem of overcapacity that resulted from major investment in nuclear power generation combined with an unanticipated decrease in the rate of growth in national electricity demand following the 1973 oil and economic crisis. Faced with this situation, EDF needed to develop new uses for the electricity it produced, hence the decision to focus on domestic heating. This strategy proved extremely effective at the time: from the late 1970s into the 1990s, more than 40% and up to 70% (72% in 1988) of new built dwellings were equipped with electric heating in France (Bouvier, 2012: 38). Yet it was to be strongly criticized soon afterwards for its low efficiency and its high cost especially for households. As this case shows, dominant technologies are not inherently superior to other available, but more seldom adopted, alternatives.[2]

On the whole, at least in old-industrialized countries, coexisting processes of active mediation (between infrastructures and appliances and between appliances and practices) have sustained the advent of conventions, practices and expected standards of comfort, convenience, cleanliness and connectivity that are distinctly resource-intensive[3] to maintain. In what has become a repeating pattern, related systems of provision are reproduced at different scales: in networks of power, water and data; in building design (plumbed in, connected, wired) and in the details of kitchen and bathroom planning, for example. Such arrangements are also advocated and promoted by the media (in the name of progress and modernity), by the utility industry (in the name of their business interests) and by governments and public bodies (in the name of economic, social and spatial development). Connected and powered devices and appliances have consequently become firmly integrated into the fabric of daily life: being essential to what are seen to be 'basic needs', as well as to societal rhythms and expectations, especially in terms of reliability, with substantial implications for the functioning of the networks on which the fulfilment of these needs depends.

In short, the ubiquitous development of networked infrastructure systems has been as a rule (even in more recent instances such as the internet), a self-reinforcing process acting on the multiple dimensions (material, symbolic, cognitive) of multiple practices. And in one way or another, it has brought these practices into line with the interests (and ambitions) of network service providers – that is, in generating ever-growing demand for access to networked infrastructures, and for the services they make possible. Although the dominant narrative of the last century or so has been one of escalating demand rooted in infrastructural systems requiring the emergence of ever more energy intensive practices, other narratives and trajectories can be imagined, and there are already increasingly significant counter tendencies.

**Adapting or shrinking infrastructures: stabilising practices**

In general terms, demand for networked services and resources is still rising, but in certain places and sectors, other trends and dynamics are taking hold. For example, electricity consumption has stagnated and even slightly decreased in Europe since 2007.[4] Some factors accounting for this unprecedented situation reflect competition from other energy suppliers or from self-provision. However, some point to decreasing demand, including the consequences of the 2008 economic crisis (poorer households and, especially, less prosperous businesses use less energy) and the effect of public policies aimed at curtailing energy demand and promoting efficiency in order to reduce $CO_2$ emissions.

In France, for example, total electricity consumption has remained stable at just under 480 TWh per year since 2010, having previously increased steadily until 2007. Whatever the reason, any stabilising or decline in demand challenges the suppliers' traditional business model, which depends on selling ever larger quantities of resources. As a consequence – and sometimes also as one of the causes – of such decline, strategies have been developed based on the provision of 'energy services', including 'energy efficiency solutions' which promise to generate and perhaps increase supplier revenue despite selling less volume.[5]

The ability to profit from selling energy services depends on the potential for increasing the efficiency with which such services are delivered. Exploiting such opportunities, in turn, depends on reaching beyond generation and distribution, getting involved in selecting and operating 'appliances' and sometimes reconfiguring buildings and the contexts in which they are used. An energy services company will, for example, design a tailor-made 'solution' for typically large-scale energy consumers, such as a more energy-efficient heating or cooling system, or industrial process, that will result in the supplier selling less energy to its client. This involves some reshuffling of utilities' roles and responsibilities, but it seems that within this immensely complex sector, there is considerable scope for 'non-traditional' business models and for new and existing organisations to carve out niches for themselves and to remain profitable in the context of stable or reduced resource consumption.

Taking a broader view, there is nothing new about the idea of capitalising on demand reduction. Policies and markets for 'energy efficiency' have been actively developed and implemented from the 1970s oil crisis onwards. Then, as now, there was, and there still is, money and political gain to be made from investing in products which use less energy than those they replace.[6] Lower energy appliances have entered the market, governments have developed and promoted energy labelling schemes and standards, and the fluctuating economics of 'payback periods' have justified the adoption and installation of devices which reduce consumption. Whilst many of these measures have been adopted in a wider context of *growing* demand, there is no denying their impact. For example, swapping 45 million incandescent bulbs for lower energy compact fluorescent alternatives reduced Mexico's energy demand by over 3,000 GWh a year (SENER, 2015). In addition, and in contrast to previous scenarios in which gas or electric heating was simply added to existing buildings, regulations and design strategies have been adjusted to conserve fuel and power. The emergence of the Passive House 'concept' and related low energy standards exemplify this trend (Passive House Institute, 2015).

In combination, the widespread introduction of more efficient appliances and systems has the potential to diminish demand in ways that matter for the operation and (re)design of power or water supplies. Conventional infrastructures of provision might shrink or be rearranged as the profitability of suppliers becomes less and less dependent on the quantity of gas, water or electricity that is sold. And, as observed above, the pursuit of efficiency is compatible with an income growth strategy. Even so, it is important to notice that efficiency policies, efficient products and energy service providers exist in a space that is defined and limited by the shared ambition of *reproducing current standards and practices*, although with a lesser use of resources.

The adoption of lower energy technologies almost always involves some minor modification in practice. For example, people adjust to fluorescent or LED lighting and they get used to washing machines that take longer to run than their predecessors. Similarly, interpretations of 'normal' service are always in flux. In particular, in areas of daily life where practices are more obviously on the move or where there is as yet no shared understanding of 'need' – as has been the case with IT or digital connectivity over the last decade or so[7] – the concept of efficiency is more contested. But when efficiency measures relate to established practices, they are generally introduced and positioned with reference to a shared understanding of proper provision. Because of this, discourses of efficiency go hand in hand with a persistent commitment to the project of maintaining current ways of life and associated interpretations of progress and growth. These commitments reproduce socially and culturally embedded understandings of 'networked normality' – including expectations that power is always 'on', that there is permanently reliable communication and that the rhythms and interdependencies of 'modern' living are here to stay.

This is not a passive stance. In so far as the efficiency agenda is designed to meet present needs with fewer resources, it has far-reaching and powerful consequences: helping to preserve and reproduce what are treated as taken-for-granted, non-negotiable standards. On the one hand, this means there is no deliberate programme of actively extending energy demand by 'powering' new or existing practices, as was the case before. Equally, there is no intention of undermining existing regimes of institutional relations, networked systems, consumer-provider roles or related complexes of social practice.

In short, there is evidently some flexibility in how infrastructures are configured and in how the material elements of practices are defined and delivered. As a result, it is sometimes possible to increase appliance efficiency behind the scenes and without substantially affecting the ongoing conduct of related practices. How much scope there is for *decoupling* resource consumption from service provision, and where this potential lies, varies from one practice to another. At the same time, that scope is limited by the shared ambition of reducing resource demand *without* compromising service delivery associated with 'normal' practices. The irony is that far from being natural or inevitable, contemporary interpretations of need and (standard) service are themselves outcomes of previous infrastructural configurations.

This is not the only possible strategy. In so far as 'needs' are made and not simply there, and to the extent that infrastructures and appliances help constitute practices (which then depend on them), analyses of configurations which enable and generate *different* complexes of social practice promises to provide new insights into the malleability of the practice-infrastructure nexus.

## Reconfiguring infrastructures, appliances and practices

We began by noticing that the supply-driven imperative for ever-increasing resource demand can falter. Recent trends suggest that future infrastructure-practice configurations need not rest on an economic model of ever-increasing resource consumption, nor do they need to perpetuate current interpretations of 'normal' practice. There is, for example, growing recognition among climate change experts and policy-makers that improvements in energy efficiency will be *insufficient* to meet carbon emissions targets and that more radical changes may be required. In this context, it makes sense to wonder whether infrastructures, appliances and practices might be reconfigured in ways that call for very much less consumption.

Looking back, the proliferation of individual household appliances (toasters, freezers, washing machines, air conditioning, etc.) is in keeping with an assumption of increasing energy (and water) consumption. Looking ahead, it is possible to envisage systems and technologies that enable more collective forms of provisioning (for example, shared laundries, district heating systems), increasingly IT-based, partly 'dematerialised' services or less energy-intensive systems (unfrozen food chains) or novel forms or standards of provision (wearing insulation, reducing the volume of heated or cooled space).

Greater geographical proximity between energy supply and demand might, in addition to improved supply efficiency, favour correspondingly localised variations in practice – as distinct from expectations of homogenous 'standards' and conventions. These might better reflect specific conditions, such as the local climate, along with local resources, constraints and opportunities more generally. For example, in hot countries we might imagine the return of the siesta, the habit of closing the shutters during the daytime, new conventions of clothing or a re-greening of urban environments. More generally, the multiplication of diverse local configurations might facilitate social innovation and the emergence of novel infrastructure-practice arrangements that prove better adapted to the prevailing conditions.

Since everyday practices interact in time, in space and through diverse social and material systems, significant and widespread reductions in demand for (increasingly networked) resources imply correspondingly systemic innovation and change. In thinking about the types of transformation involved, it is important to recognise that there are already extensive variations in how seemingly shared practices are enacted and that these variations are, to an extent, reflected in the amount of resources that different social groups consume. People living ‘off grid’ (which in general means off energy grids) are at one end of this spectrum. These currently ‘extreme’ cases are often and perhaps necessarily small scale and they are, to an extent, precisely characterized by being set apart from and defined in contrast to the ‘mainstream’. We do not consider ‘off-gridders’ as models to follow, in a normative way. Rather we use them for analytical purposes. From this point of view, the experiences of voluntary ‘off-gridders’ provide insights into the types of reconfiguration at stake. In particular, they highlight issues of time and labour, space, institutional involvement and change in the organization of everyday life. Furthermore, by emphasising notions of autonomy – metabolic and political – off-gridders tend to question contemporary (Western) standards of material consumption and waste that support and are supported by prevailing infrastructural arrangements.

Off-grid experiences suggest that being deprived of networked supplies increases the time, effort, attention and often money spent in providing one’s own water and energy, and in communicating with others or disposing of one’s waste. For example, the overall time and work involved in domestic chores is greater when using hand- rather than grid-powered appliances. This has further implications for the rhythm of daily life. Amongst other things, it means that less is done in any one day, fewer tasks are accomplished and each calls for greater dedication and effort. One relevant insight is that there are different ways of evaluating the costs and also the benefits of seemingly slower ways of life and of more direct interaction with seasonal variations of heat and light (Vannini and Taggart, 2013b). A second is that whether seen as a step ‘back’, a drop in standards or an advance, lower-power living entails a range of quite significant changes in the temporal ordering and organisation of what people do.

The use and experience of space is also key. Full central heating has reinforced a notion of space- rather than person-heating and has enabled the spread of people and of energy-demanding practices around the home. Those who live off-grid tend to use space in different ways, often concentrating activities around more localised sources of heat and light. Such arrangements are associated with specific interpretations of what it means to be comfortable and of how this might be achieved. Vannini and Taggart reach the following conclusion, based on a study of 159 off-gridders:

> as the experiences of off-grid homes show, in no way is domestic visual comfort achievable only by flicking on an electric lightbulb powered by distant sociotechnical assemblages. Comfort is, in fact, not a uniform experience and off-gridders’ practices show vividly what it means to achieve it differently, in variable intensities and through alternative entanglements of nature and culture
> (Vannini and Taggart, 2013a: 1076).

These experiences underline the negotiability of thermal and visual comfort: as new interpretations take hold, these become the benchmarks against which other arrangements are judged.

Third, Vannini and Taggart’s analysis of off-gridders’ experiences highlights patterns of organisational and material (in)dependence. The social and institutional arrangements associated with networked infrastructures are significantly rearranged by off-gridders, especially those who simultaneously occupy the roles of producer, distributor and consumer.

These strategies are sometimes, but not always, an expression of political commitment involving a rejection of the state, a reluctance to interact with global corporations and some resistance to mainstream ways of life (van Vliet et al., 2005). Whatever the reasoning and approach, those who produce the electricity they consume are differently positioned from those who are enmeshed within and hence dependent on the reliable functioning of much more remote systems and institutions of provision.

Many future patterns are possible, but in combination, these observations suggest that significantly lower energy configurations of infrastructures and practices are likely to involve new temporal rhythms, the emergence of new concepts and understandings of space and service (and related ecologies of materials and 'appliances' broadly defined) and different forms of social and organisational interdependence. Off-grid experiences also highlight important differences *between* practices and their relation to variously networked forms of power. As already mentioned, there are many ways of heating, lighting, cooking or communicating and an array of potentially relevant appliances and fuels. Different practices are marked by different histories and forms of power dependence. In some cases, there is ample scope for material substitution, for compromising or reinterpreting standards of performance and service or for falling back on old methods – for example, washing by hand or using a hand-powered drill (De Decker, no date). More generally, practices and related appliances are increasingly linked in various ways. These forms of interdependence are normally invisible. But as extended power cuts reveal, water supplies routinely depend on an electrical supply, as do gas heating systems, automatic garage doors or mobile phone masts.

Practice-specific and practice-connective features are both important in thinking about where and how more extensive resource demand reduction might begin and about the possibilities for establishing alternative configurations. In this context, existing methods of 'service provision' illustrate the scope for enabling certain practices in different ways necessitating less energy and resources – for example via forms of efficiency.

Whilst these methods are typically designed to mimic standards which are, in effect, born of an age of energy and resource plenty, the examples of off-grid reconfiguration discussed above indicate that other formulations are possible. For example, the increasing digitalisation of relations between infrastructures and their use(r)s may facilitate a transition from one-size-fits-all infrastructural environments to a much greater variety of tailor-made arrangements, thus opening new 'spaces' in which a corresponding variety of infrastructure-practice configurations might evolve. These new spaces may be unattractive or remain dormant when energy prices are low, but prove to be extremely valuable under conditions of more or less sudden and large rises in energy prices or increasing constraints on energy use.

## Configuring the future?

In this chapter we have presented three 'ideal typical' configurations of infrastructures and practices and we have done so as if these forms were of equal status and as if they could be detached from specific situations and historical contexts. We have used this scheme to argue that networked infrastructures do not necessarily constitute 'technologies of growth' (type 1) and in particular that they do not necessarily call for and support ever more service- or resource-intensive practices. Under specific conditions, 'shrinking' infrastructures (type 2) may prove profitable for utility companies, users and the environment (in terms of resource use) alike. Both these configurations (type 1 and type 2) help reproduce specific concepts of ‘normal’ practice, laying down multiple, sometimes reinforcing, tracks of ‘path dependence’; representing ‘sunk costs’ in terms of hardware and – perhaps more powerfully – anchoring normative visions of everyday life. By contrast, the third formulation (‘reconfiguring infrastructures’ (type 3)) entails and depends on establishing practices that are positioned in opposition or at least as an alternative to those associated with mainstream infrastructural provision.

Looking across all three forms, the question is whether it is possible to imagine and realise future scenarios in which infrastructural developments go hand in hand with significant transitions in practice resulting in a systemic decline in demand for energy or other resources.

In this chapter we have argued that any move in this direction depends on a better understanding of how scenarios of growth, persistence, decline or disconnection are formed through the interaction of variously obdurate (or variously dynamic) business models, systems of provision, material arrangements and complexes of social practices. We conclude that whatever arrangements take hold in the years ahead, one thing is sure: they will be informed by past and present concepts of progress, by institutions and systems of provision and by a material legacy of buildings, generators, pipes and wires. In making some trajectories more likely or seemingly more viable than others, this accumulation of infrastructure-practice configurations throws shadows deep into the future. At the same time, the fact that infrastructures enable and co-constitute diverse social practices and that they do so through multiple forms of active mediation ensures a measure of restless, ongoing and potentially steerable change.

## Notes

1. Throughout the chapter, the discussion is based on the supply and use of infrastructure services in the domestic sphere. We do not discuss in any depth the (potential) dynamics of practices in the manufacturing or service sectors, even though they represent a significant share of total resource use.
2. This scheme was subsequently criticised given the cost and financial burden of using all electric heating and the problems this presented especially for rural households, which had few other options and which generally lived in larger and more poorly insulated dwellings than their urban counterparts.
3. Compared with those they replaced.
4. For the statistical information in this and the following paragraphs, see RTE (2015).
5. Other strategies include expanding the supplier’s service area and/or diversification into other sectors (utility or otherwise). See, for example, Florentin (2015).
6. See, for example, the work of the International Energy Agency (2015) which treats ‘efficiency’ as a fuel or the ambitions of the European Council for an Energy Efficient Economy (n.d.), which claims on its website’s homepage that ‘since the 1970s, energy efficiency has contributed more to our economic prosperity than any other single source of energy supply’.
7. These examples currently have more in common with ‘type 1’ configurations of expanding infrastructures and growth.

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