Concepts and methodologies for a new relational geography of energy demand: social practices, doing-places and settings

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Abstract

Understandings of space as not an objective surface or container but rather a set of relations that are continually made and re-made have become well established within the social sciences, yet they remain noticeably absent in how energy demand research is understood and undertaken. This is, in part, because relevant vocabularies and methodologies remain minimally developed. This paper therefore establishes a conceptual approach, vocabulary and set of methodologies that offer new opportunities for understanding the spatial deployment of energy. In doing so, it works at the intersection of energy geographies and theories of practice, engaging in particular with the concepts of place, anchors and settings from Schatzki's site ontology. After introducing these concepts, the paper outlines how they can provide a more conceptually sophisticated understanding of the energy demand dynamics of a range of changing social practices. It then presents methodologies capable of foregrounding the relational spatialities of practice and energy demand. It argues that carefully working through how energy demand arises as a consequence of social practices, and how spatialities of practice matter for understanding energy service provisioning, helps in developing methodologies that push energy research into refreshingly unfamiliar explorations, analyses and strategies for addressing associated challenges.

Keywords

relational space; place; methodologies; practice theory; energy provisioning; energy demand

1. Introduction

The use of energy is undoubtedly a spatial phenomenon: as Lefebvre states, “energy has to be deployed within a space” [1]. How exactly this apparent fact is interpreted, however, depends significantly upon the conceptualisation of space that is adopted. Conventionally and intuitively, space is thought about as an objective surface or container, on or in which locations can be marked out. Yet alternative understandings of space as “the product of interrelations” [2] that are continually made, rather than given, have become fundamental to various lines of spatial thinking across human geography and the social sciences more generally [3]. This paper starts from the observation that this important shift in how space is understood has been noticeably absent in the conception and undertaking of research on the demand for energy. There exists a well-developed vocabulary for discussing energy demand in objective space (and time) – using not only proper names of locations, but also measured distances, scales, coordinates and rates (e.g. kilowatt hours). So, for example, insights might be made about travel patterns between coordinate locations and across measured distances within a particular area of a city, or of rates of energy demand within delineated country borders [e.g. 4]. No comparable vocabulary, however, has been established for discussing the spaces of energy demand in relational terms. The connected methodologies that produce and proceed from understandings of objective space similarly lack well-established comparators. As a result, researchers have had few tools with which to investigate the processes of ‘deployment’, whereby energy is used for particular purposes that are themselves embroiled in the relational and on-going making of spatial phenomena. The central aim of this paper is to establish a conceptual approach, vocabulary and set of related methodological strategies that can advance new understandings of how energy demand and space are interrelated.

These ambitions are shaped by the observation that relational spatial processes could provide new understandings of both on-going changes in the world around us and the energy-related challenges that these processes are caught up in. For example, there continues to be an extraordinary diffusion of information technologies, which are variously incorporated into all sorts of everyday activities at home, work and in moving around [5-7]. Practices such as shopping are shifting in terms of where, when and how different goods are being bought. Flexible working arrangements increasingly mean that the practice of work, for some people at least, does not happen only in spatially fixed and determinate work-places, but can also take place on the move, at home, in coffee houses, or when (apparently) on holiday. These and many other smaller and larger shifts in what is being done where and when - and what is available to be done where and when - all have consequences of different extents and forms for spatial and temporal patterns of energy demand and how these are being made across society [8]. These consequences in turn have various implications for ambitions to decarbonise energy systems, reduce energy demand overall [9] and manage peaks and troughs in energy system load in relation to supply-side dynamics [10-12].

We do not seek in this paper to focus on any one of these examples of changing social dynamics, or their specific interrelation with energy system challenges, but rather to lay out tools that can potentially be deployed to a variety of ends. Our main contribution is thus conceptual and methodological. This has value, we would argue, as having alternative ways of conceptualising phenomena, and abstracting from what appears to immediately confront us, can enable and stimulate new research designs, alternative units and trajectories of investigation, novel insights and creative approaches to solving existing problems.

In pursuing our aim, we position the paper at the intersection between two identifiable movements in social science research on energy. The first is a reinvigoration, if not entire reinvention, of the field of energy geography, or as Calvert [13] suggests, energy geograph*ies*, concerned with bringing the full range of conceptual resources now running through human geography and its subfields to bear on energy questions - in all of their diversity and complexity [14-16]. Whilst some geographers have begun to consider energy concerns in terms of the dynamics of relational space [17, 18], including by approaching energy poverty as a "relational assemblage" [19, see also 20, 21], as yet these instances provide a limited set of resources for thinking more broadly, and more precisely, about how energy demand and space are interrelated. Moreover, this work has drawn upon varied understandings of social action and therefore presents challenges in terms of the extent to which their insights might be brought together.

The second movement is the bringing of concepts from theories of social practice into the analysis of energy demand, starting from the foundational position that demand is constituted through the social practices of everyday life [8, 22]. The use of energy is here understood as part of the doing or performing of many varied practices such as cooking, working, communicating, or laundry[1] [24-26] and at an aggregate level, demand is a product of the vast array of interwoven practices out of which the ordering of society is made [27, 28]). Engaging with theories of practice is particularly helpful for our interest in thinking relationally because this approach emphasises that the deployment of energy is not simply about moving energy to appropriate places (as may be a concern for the managers of electricity grids), but also about how energy connects to the evolving arrangement and use of things for specific purposes and actions – such as, for example, the growing global use of air conditioning to cool indoor environments [29-31]. As yet, however, there has been little systematic engagement with the spatial dimensions or implications of working with a social practice approach to energy demand and its ongoing dynamics – in comparison, associated temporalities have been more substantially explored [11, 32-34].

In developing this intersection of academic interests, we draw specifically upon the work of Theodore Schatzki and his longstanding concern for establishing an ontology of the social that is centred on practices and "site-based" [35-38]. All theories of social practice start not from the individual and their choices and behaviours [e.g. see 39], but from the idea that the social world is continually reproduced through a range of diverse practices that people perform [35, 37, 40, 41]. These practices could be seen to occur in objective spaces, but more importantly they are inextricable from social space, which Schatzki, following Heidegger, defines "as the opening and occupation of sites for human existence" [36]. Whereas objective space is "at least to some extent independent of human existence" [36], social space is inseparable from human agency, and therefore studying the practices of social life becomes de facto a means of studying social space. This is not to say that studying social, relational space involves always focusing upon people actively doing things in the present. Rather it acknowledges that: "physical spatial relations are not … the only sort inhabiting social life" [35] and thus space is about not only distances on maps or how

[1] There can be considerable debate about how to appropriately name practices (e.g. [23] A. Warde, What sort of a practice is eating?, in: E. Shove, N. Spurling (Eds.), Sustainable practices: social theory and climate change, Routledge, London, 2013, pp. 17-30.) as this is always a task undertaken by the analyst. There is no one right answer; the expansiveness or precision of these categories can be used to strategically highlight different dynamics, and either reinforce or bring into question social understandings of what it is that people are doing.

particular cities are laid out, but the human activities that bring maps, land zoning, road layouts, shopping districts and more into existence and that sustain or shift their form over time. This provides the starting point for articulating an understanding of space that is open to both its objective and relational forms, and which, whilst sharing something in common with other ways of thinking about the spatial [42], provides a distinctive and thorough integration with social practice.

By building from Schatzki's work and identifying a specific set of concepts and methodologies that link energy demand to practices, we provide in this paper a way of foregrounding the spatial relations within which the constitution of energy demand is embroiled, without immediately doing so in terms of objective and physical understandings of how practices are performed in spatial terms. We begin by introducing key concepts of *places, anchors* and *settings* from Schatzki's ontology, highlighting how these provide a means of discussing and summarising aspects of relational space. We then ground these abstract concepts by articulating specific examples and implications for studying energy demand. The third step of our argument is to make explicit the methodological principles and processes that arise from this conceptual foundation. In this way we build up a vocabulary and set of methodological strategies that are carefully grounded in understandings of practice and relational space, but which also provide new avenues of investigation.

2. Schatzki on places, anchors and settings for social action

The relationship between spaces, times and human activities is a longstanding theme within Schatzki's work, but one marked by notable shifts from an early focus on space [36] to the later discussion of 'timespace' as a unity [38]. Of particular relevance here is how Schatzki understands place in relation to human activity. For Schatzki, human activities are performed within an array or "matrix of places and paths" [35]. Here place does not, as in some geographers' work, suggest emotional attachment or sense of place, but rather "simply places to carry out particular activities" [36]: "A place is a place to X, e.g., a bed is a place to sleep, a table a place to eat, and a bus stop a place to catch the bus. As these examples demonstrate, places are defined by reference to human activities" [36]. The term 'path' then appears as a sub-type, or "particular sort" (2002: 43) of this broader category of places: paths are "places on which to reach Y from X (routes)" [36]. This gives places and paths a distinctly relational quality. So rather than being located definitively at some physical site, places and paths are spaces within or along which particular types of activity are understood to make sense and to be practically or sensibly possible. Paths for a footrace might therefore be performed from the starting line to the finish line on a marked indoor running track – in this case taking the form of a fixed and long-lasting physical path for the practice of foot racing. Alternatively, a footrace may be performed along a path from a pile of jackets to a bush in the middle of a large grassy field, a far more ephemeral and physically indistinct form of path, but still understood as an appropriate place for racing.

Whilst this way of thinking about the making of spatial relations is analytically helpful, the many alternative social scientific and colloquial uses of the terms place and path gives evident scope for misunderstanding. In what follows we therefore refer to a place as a 'doing-place' and a path as a 'doing-path', in order to emphasise the relational Schatzkian

way of seeing these as places to do activities.[2] That is, they are always defined in relation to the doings that make up practices. Any one practice has a set of types or forms of doing-places within which it is generally understood to be performable. Through reoccurring performances of that practice, in specific instances of those doing-places, those understandings are then reproduced and sustained. So a running track is sustained as an appropriate doing-path for footraces for as long as footraces continue to be performed in this way. If footracing became routinely carried out through alternative spatial relations, then the set of doing-paths for footracing would be understood differently. Places and paths thus come in varied forms, but always relate to particular activities, and thereby to the understanding and achievement of related goals and aims (e.g. being first across the finish line).

There are two further terms that Schatzki introduces into his spatial vocabulary that we can usefully deploy – settings and anchoring. Settings are where the doing-places of multiple practices come together and intersect. Schatzki defines settings as "loosely or tightly bundled totalit[ies] of places" [36] that have either barriers or a particular organisational structure demarcating them. We can also think about them as particular bounded sections of the "matrix of places and paths" [35] within which the ongoing flow of human activity is being performed. A prison, railway station or supermarket would be examples of settings that are appropriate doing-places for multiple practices and are demarcated or bounded in different ways. Further examples will be elaborated later in our discussion.

Anchoring, as the final term to be explained, relates to the objects that have already been evident in Schatzki's definitions of (doing-)place and (doing-)path – a bed for sleeping, a table for eating, a starting line and finishing line between which one runs a footrace. As Schatzki notes, (doing-)places are in varying ways "anchored" at, and "conditioned and constrained by", a range of objects [36]. The practice of sleeping is therefore conventionally anchored at, and conditioned by, beds. Yet at times it can also be anchored at other objects – airplane seats, office chairs and desks, theatre seats, or (in the case of babies) prams or strollers. So any one practice may have either a narrow or a much more diverse set of objects that anchor the doing-places for that practice. In addition, it is often a combination or connected network of objects that need to come together to anchor the doing-places for any given practice (e.g. repairing a car generally needs sets of tools, ramps, lights and so on).

Furthermore, whilst one practice, such as sleeping, might have multiple anchors for its doing-places, one object might also anchor doing-places for multiple practices. Smart phones and computers are excellent exemplars, as they enable, condition and constrain what has become a very diverse set of activities such as emailing, playing games, watching films and shopping for groceries. This relationship between doing-places and objects can also be considered in relation to settings, which "are anchored in configurations of objects" [36] rather than singular ones. A café is a setting that has places for making coffee, places for paying one's bill, places for cleaning dishes, and places for meeting with friends, and these are anchored in the configuration of espresso machines, cash registers, card payment terminals, dishwashers, sinks, tables and chairs that constitute the setting of the café.

[2] As doing-paths are sub-types of doing-places, in the rest of the paper we will normally take the latter to be inclusive of both, using doing-path only where it is specifically relevant.

This dynamic of anchoring highlights both practical dependence and social convention. To some extent, the activity at doing-places depends upon and cannot be undertaken without the objects at which they are anchored. Making coffee requires coffee beans, cups, water and machines to help brew the coffee (and of course energy to power them, to which we will turn in due course). Yet this relation between doing-places and objects is also about shared social understandings of what is required to successfully perform activities in the pursuit of related goals or aims. The proliferation of different types of coffee drinks, and the changing fashion within these drinks over time, is a social and cultural phenomenon. Such social understandings prevent simple technological or material determinism in linking objects to activities. As noted earlier, shifts over time in shared understandings of how practices are to be performed can mean that doing-places and anchoring objects can become newly attached to, or detached from these practices. Practice—doing-place—object relations are always made rather than fixed, and therefore always open to future change.

The practice of making a phone call provides another example to reinforce this point. Until relatively recently, making (or receiving) a phone call was an activity that was related to particular anchored objects (fixed-line telephones) found in particular types of doing-places and settings (a room at home, an office at work, phone boxes or booths in a public square). There was a shared understanding of the doing-places for enacting the activity: attempting to take or make phone calls in other settings would be understood to be 'play-acting' rather than a proper enactment. This strong anchoring to particular objects in particular settings has now been radically shifted and disrupted by mobile telecommunications, to the point that making or taking a phone call has become a widely diffused activity occurring in a huge variety of settings, both mobile (e.g. transportation) and static, and socially understood to be appropriate to these in a way that wasn't the case before. Where one *cannot* make or receive a phone call is shaped both by material relations (whether one's mobile phone has signal in a given location), but also by social understandings and rules that restrict the use of mobile phones in some settings such as cinemas, theatres, churches or 'quiet coaches' on trains.

Reflecting upon our discussion in this section, it is important to highlight that the spatial dynamics of practices can be discussed in relation to doing-places, doing-paths, settings, and anchoring objects *without* any recourse to conventional categories of objective, cartographic space. We may mobilise these ideas by thinking of specific physical spaces – a particular café, phone box or running track that we have encountered – but each of these can also be discussed in terms of abstract spatial relations. Of course it is also possible to translate between the abstract/relational and the physical/objective, but this is always a contingent relationship. As Schatzki notes, the anchoring of practices at physical objects establishes the "objective locations of places and paths" [38], connecting map-able spaces with doing-places that are intelligible for particular activities. It would therefore be possible, for instance, to map not only where mobile phone service is not available, but also where (and when) mobile phone use is not permitted in the cinemas, theatres and churches of a particular city. In doing so, the dynamics of relational doing-places and doing-paths might be connected up with their particular manifestations in objective space, but only in a contingent way and with recognition of the potential instability of their connection.

Furthermore, it is important to note that while the examples taken up in the rest of this paper are predominantly those associated with the end users of energy and thus settings that appear focused upon consumption, these concepts could equally be applied to a

consideration of the practices involved in producing energy and their associated settings, such as nuclear power stations or wind turbines. Though the spatiality of such settings can be described objectively in terms of their map-able locations, it can also be addressed in terms of the doing-places, settings and anchors for supervising staff, maintaining equipment, regulating output, enacting local community meetings and similar ongoing or more periodically performed practices. Whilst we do not consider this approach in detail here, pursuing this analytical trajectory would offer interesting ways to consider how the production of energy is socially, as well as technologically or materially, configured in terms of practice and doing-place relations.

Having outlined the key features, as we see and interpret them, of a distinctive relational spatial ontology of social practice, we have not yet brought energy and demand into this scheme. In the next section we turn to this task, articulating the implications of mobilising these concepts for understanding the relationship between practices and energy demand.

3. Doing-places, settings and energy demand

In the discussion so far we have utilised a diverse set of examples to exemplify rather abstracted ways of thinking about practices and space. Some of these examples were clearly ones where energy use was directly implicated, with others less so, and we did not comment directly on these features. In order to provide a foundation for focusing more directly on how energy demand emerges from a set of practices, in Table 1 we more systematically lay out a sequence of practices undertaken by one of the authors during a weekday in February. In the Table a set of possible anchors for doing-places and doing-paths are identified in relation to each practice, along with a list of settings in which these might be found. The 'might be' is important here, as this listing does not identify only doing-places and settings that were *actually* physically used for performing these practices on that particular day, but also other possible ones that *could* have been used (without attempting to derive a fully exhaustive list). This move is one that explicitly fits with the arguments already made about the relations between practices and doing-places and will serve various purposes in the discussion that follows. There are relatively few entries included for possible doing-paths because, as noted above, these are a sub-category of doing-places, and while various practices may take place whilst on the move, they need to depend on such movement (practically or by social convention) to say that they are anchored specifically in paths.

Practice	**Anchors for doing-places**	**Anchors for doing-paths**	**Settings**
Drinking coffee	Coffee cup (disposable or not) filled with some coffee		Café; Bus; Train; Office; Home kitchen; etc.
Writing and sending	Personal computer; Laptop; Tablet		Office; Café; Bus; Train; Home office;

work emails	computer; Smart phone; Internet connection through LAN, Wi-Fi or 3G/4G		etc.
Reading	Book; Newspaper; Tablet computer; Smart phone; Laptop; etc.		Office; Home living room; Café; Bus; Train; Doctor's waiting room; Library; Cinema queue; etc.
Commuting from work		Roads; Train tracks; Public Paths; etc.	Bus; Train; Car; Cycle paths; Walking paths; etc.
Yoga	Yoga mat		Room in a community centre or gym; Space of an appropriate size at home
Shopping for groceries	Storage area for carts and baskets; Checkout stands; Refrigerators and freezers; Personal computer (for online shopping); etc.	Aisles and shelves at the supermarket	Grocery store; Home office
Cooking dinner	Stove/hob; Grill; Microwave; Fridge; Countertop; Cupboards; etc.	Kitchen floor and counters	Home kitchen; Restaurant kitchen; Café; etc.

Table 1: Examples of possible anchors and settings associated with a sequence of practices

What then can be gleaned from such a starting point in terms of the possibilities available for analysing energy demand and its dynamics? Evidently one could consider more carefully the different possible objects at which practices are anchored, particularly those that are energy consuming - i.e. those objects that need to be both present and operational through being connected to an energy supply infrastructure in order to constitute an appropriate doing-place. Practices can have multiple doing-places that relate to different possible ways of achieving their aims or goals, and depending upon which object is anchoring a doing-place there can be significant differences in energy demand. For example, there are different amounts of energy consumed by stoves and microwaves, and as a result different ways of

cooking one's dinner will have different levels of energy demand. This type of variation is already well acknowledged within energy literature, both in terms of more behaviouristic approaches that focus upon people's choices of which technologies to use [e.g. 43] and research that emphasises how certain objects came to be important parts of practice [e.g. 44 on freezers, 45 on shopping carts]. It is also central to notions of 'mode-shifting' in transport studies, where the modes for 'doing journeys' are normatively positioned as alternatives with strongly different energy use implications [e.g. 46, 47]. However, focusing only upon the energy demand related to these anchoring objects is to make a very limited use of the ideas we have outlined, and there are other important approaches to work through.

3.1 Energy services and the practices in settings

As a first step we can observe that there are integral forms of energy use that are not readily extracted from this table but which are crucial to overall energy demand. Each of these practices depends upon energy services, which Fell defines as activities that are both "performed using energy" and "means to obtain or facilitate desired end services or states" [48]. Space heating is thus a means of obtaining thermal comfort, lighting a means of being able to see in dark settings, and digital connectivity a means of sending or receiving messages or information. Though discussions of Energy Service Companies situate such services as the things explicitly demanded and paid for by consumers, our usage of the term is more broadly interested in how energy becomes used for ends and processes of relevance to practices. In some instances, practices require these services in order to be successfully performed – cooking in a restaurant kitchen that does not have any windows depends upon the provision of lighting; sending work emails relies upon the provision of digital connectivity through 3G/Wi-Fi/LAN infrastructures. In other instances, the provision of such services is not *practically* necessary for a particular practice, but socially normalised – customers would find it strange and a cause for complaint if a café or grocery store was not appropriately heated (or cooled) even if drinking coffee, reading, and shopping for groceries are not practically dependent upon a particular indoor temperature. In either case, what is important for the practitioner is that the services are embedded in particular settings, not how exactly they are provided. The particularities of heating or lighting infrastructure, whilst very consequential in energy demand terms, are of little consequence for many practices. Whilst a space of a comfortable temperature is required for doing yoga, how the room is heated or cooled doesn't much matter so long as the temperature is reached. Similarly, the embedded energy of appliances is of little consequence so long as they facilitate appropriate end processes, states or outcomes.

Put differently, many practices, even where they rely upon energy services for the achievement of their aims, remain ambivalent to the material infrastructures undergirding these services.[3] This is not to say that some infrastructure might not be deemed inferior for reasons related or unrelated to the practice at hand – one might dislike the aesthetic of compact fluorescent strip lighting and be frustrated because it cannot be easily dimmed during a yoga class, but it nonetheless would allow a class to proceed after dark. Regardless of such understandings, however, in terms of the successful accomplishment of the practice

[3] Of course for some practices ambivalence is not possible – as for example in the case of practices related to maintaining and provisioning for indoor fireplace heating ([49] M. Jalas, J. Rinkinen, Stacking wood and staying warm: time, temporality and housework around domestic heating systems, Journal of Consumer Culture 16(1) (2016) 43-60.)

(as both practically and socially defined), the need for services is not always dependent upon specific infrastructural configurations – we need to be able to see, or to access the internet, not necessarily compact fluorescent strips or a LAN connection. As a result, considerable variation can exist in the energy demand associated with the doing-places of any one practice, *even where* these are anchored by the same objects. Whilst particular types of doing-places may facilitate the same activities, when performed in objective space they cannot be assumed to all be equivalent in terms of energy demand. The specificities of such relationships become empirical questions.

Understanding the energy demanded in the course of doing practices thus depends additionally upon a consideration of the settings in which they are undertaken, and the practices that provision and maintain infrastructural arrangements and operational processes in these settings. For example, Table 2 builds upon one example in Table 1 to consider the practices that affect the provisioning of energy services in a Café. We have purposefully selected a setting that is not intuitively the most obvious example for thinking about energy services in order to highlight how such services are more widely enrolled in practices than often acknowledged.

Practice	**Anchors for doing-places**	**Anchors for doing-paths**	**Setting**
Opening up the café	Thermostat; Light switches; Power switches; Locks; Signs; etc.		Café
Fixing or maintaining energy-service infrastructure	Heaters; Lighting fixtures; Food and drink machines; Refrigerators; Wi-Fi unit; Stereo and speakers; etc.		Café; Repair shops
Setting opening hours	Computers; Shared calendars; Documentation about competing cafes; Franchisee handbooks and regulations; etc.		Office (in café or elsewhere)
Designing the café	Computers; Trade magazines; Floor plans; Service regulation documentation; Engineering and technical documents;	Potential rental locations (site visits)	Offices of investor/owners, architects, interior designers, construction contractors; Industrial fittings

	Architectural designs; Documentation of existing architecture and infrastructure; etc.		shops

Table 2: Practices and doing-place anchors affecting the provisioning of energy services in a café

When asking a different question then – how levels of energy service in a café are established – a different set of practices becomes relevant. Though these practices are not necessarily temporally synchronised with drinking coffee, sending work emails, or reading in a café, and indeed may not necessarily even take place in this setting (as some could take place in more distant offices etc.), they shape the operation or the materiality of the café setting itself, affecting the provisioning of particular energy services. Taking up a relational geography of energy demand can thus involve consideration of how one setting, such as a café, supports multiple doing-places, but also how other doing-places affect the energy services in that setting. It is not only about how activities overlap in one space, but about how the many activities contributing to particular practices (e.g. running and using cafés) have doing-places that might be distributed quite widely across objective space. More simply put – the energy demanded in any one setting is shaped by practices both within and outside of that setting.

From a practice perspective then, it becomes crucial to see energy demand as the outcome of distributed agency exercised through sets of interlinked practices. Much of the energy used in settings is (at least potentially) shared amongst many people in terms of services like space heating, lighting and digital connectivity. Moreover these services are provisioned and maintained through a set of activities performed by many different people (employees, managers, architects, franchise owners). As Shove et al. [27] have highlighted, those who design settings have considerable influence upon built infrastructures and can thus encourage and support particular patterns of energy demand. Yet even ‘soft’ infrastructure such as opening schedules and staff rotas can be important to the realised provision of energy services, and therefore design professionals are not the only groups whose practices are consequential for understanding relationships between infrastructures and energy demand.

What this illustrates is that the provisioning of energy services is a collective and historically shaped accomplishment. We cannot help but benefit from energy services in a range of settings – those both publically and privately provisioned – if those settings are accessible to us. Energy services are therefore not chosen so much as encountered, as people move to and through different settings, seeking particular types of doing-places. The use of energy in these terms is less about discrete choices to turn devices on or off, up or down – as clearly in spaces such as cafés those ostensibly using energy-derived services have little power to affect their provision – than it is about encountering landscapes of energy service provision as we perform a series of practices. As this highlights, the energy demand linked to practices must therefore be analysed in relation to the energy services provided within the settings in

which they occur. The practical implications of this type of analysis may range from the importance of thinking about how commercial spaces become locked in to particular spatial and temporal patterns of energy service provisioning, querying the establishment of lighting standards in public spaces, broadening consideration of how access to energy services is related to forms of social inequality and exclusion [50], and involving even more stakeholders in the configuration of sustainability targets (e.g. not only the corporate and political actors co-designing things like electric vehicle plugs [51] but also those who fit and light commercial stores and their window displays).

3.2 The energy consequences of keeping doing-places available

In addition to highlighting the distributed agency that contributes to energy demand, considering the practices of those who provision, maintain and contribute to the smooth operation of settings shows just how much work goes into making doing-places available. While at times we may undertake this work ourselves – cleaning kitchens, doing home DIY, programming home thermostats – at other times it is part of others' work practices. In both cases, efforts are directed towards maintaining appropriate settings in which practices may be performed. Some are more direct and oriented towards specific objects – such as washing up dishes or stocking grocery store shelves – while others involve the more indirect and dispersed shaping of cultural norms – such as around appropriate sizes of coffee cups or how often one should shop for fresh food.

These seemingly commonplace activities have important consequences in terms of energy demand. As noted above, they make performances of energy-demanding practices possible. But more crucially, they make possible *the potential for* energy-demanding performances. That is, doing-places are typically available for use for longer periods than they are actually used – as the list of *potential* doing-places and paths in Table 1 also makes clear. In terms of energy, this has significant consequences. Cafés and grocery stores are heated and lit during opening hours, regardless of how many or how few customers visit them - very few cafés will have their doing-places for drinking coffee fully occupied from opening to closing, each and every day. Moreover, even after these spaces are inaccessible (because the café is closed), energy is demanded in order to maintain the availability of doing-places for the next time the space is accessible. In order to maintain appropriate places for serving perishable drinks or purchasing frozen food, refrigerators and freezers must remain on at all times. The energy implications of doing-places are not therefore entirely coterminous with the temporality of a practitioner's activity in these spaces. A great deal of energy is being demanded in order to present *possibilities* for where any one person might perform activities – even if these opportunities are not taken up. At the same time that energy demand is about the practices that are done, it is also evidently about where and when practices *could* but may not be done.

It therefore becomes important to ask different types of questions about how energy demand is constituted. What is the relationship between the energy demanded by the active use of doing-places and that demanded by maintaining the possibility of doing-places? Could some of the latter be seen as forms of 'waste', when considering either alternative types of doing-places, the social role of the related practice or the characteristics of the energy demand involved? Thinking about one practice, how does the energy demanded by keeping its doing-places available differ in relation to different settings? Might it be better to have fewer possible doing-places? As doing-places are socially shared and socially shaped, their

normalcy can be questioned. This could be particularly important in considering how patterns of energy demand might change in future. Depending upon how these questions are answered, policymakers might then create interventions that seek to reduce 'wasted' energy services through interventions related to occupancy, limiting the total number of doing-places available for particular activities through land zoning, or creating new standards for service provision levels that might complement or challenge existing standards for various infrastructures (e.g. numbers of accessible toilets, appropriate ventilation standards). There are also evident opportunities for technological innovation focused on better matching the provisioning of doing-places with their patterns of actual active use.

3.3 Considering historical changes in doing-places

Whilst the discussion thus far has focused primarily upon how energy demand relates to different settings, there are also important lines of investigation that stem from considering the relations between practices and doing-places. As theories of practice emphasise, practices exist by virtue of their continued reproduction [52], and thus their present form – in terms of such things as shared goals, understandings and conventions – is historically situated. Understanding present practices therefore depends upon understanding how practices have changed over time. Or, more relevant for this discussion, understanding the doing-places available and used in the present depends upon understanding how doing-places arise as a consequence of past shifts and changes.

There are a few dynamics that are particularly relevant in terms of energy demand. The first is changes in which objects anchor doing-places. Since different technologies have varied energy demand implications, shifts of this type can be crucial for embedding higher overall levels of energy demand in some practices. For example, we might reflect upon how doing-places for grocery shopping have transformed – not only have outdoor markets made way for indoor purpose-built stores, but, for instance, the freezer units that are now regular features of grocery stores were at one time unusual [44]. The ongoing energy demanded by reading on a tablet is similarly quite different from that demanded by reading a printed book. Changes in the objects that anchor practices can thus be important – not only in terms of representing the dependence of practices upon increased (or decreased) levels of energy demand and/or shifts in the patterning of demand in space and time, but also in terms of considering potential conflict between how different doing-places are socially valued for achieving goals related to their practice vs. the goals of energy demand management.

Such changes might also be considered in relation to settings and interlinked materialities. The increase over time of a range of information and communications technologies such as laptops, tablets and mobile phones has been supported by, and increasingly demanded, a proliferation of accessible electricity sockets in workplaces, cafés, trains, and increasingly airplanes in order to support both charging and use. As discussed earlier, the anchors for some practices are themselves anchored in various ways to material infrastructures that make them functional. Transformations in the anchors for doing-places can therefore be considered alongside infrastructural developments, with changes such as the increasing number of electricity sockets in kitchens and offices an indicator of how more and more doing-places are dependent upon electricity-demanding objects. Whilst these connections are on one hand indicative of a story of the infrastructural embedding of energy demand, they also can be seen to (always) hold possibilities for how materialities might be newly linked in the future. The rise of the electric car, for example, is emerging as an opportunity

for additional interlinkages between transport-related and other conventional categories of energy demand when it is on the move and plugged in at home or the supermarket. Possibilities therefore exist for how the electric car battery itself might become not only a 'fuel' source for transportation, but also a temporary power source for other doing-places when the flow of electricity is reversed.

As this example starts to suggest, whilst relational space does not exist without human activities, engaging with this concept need not focus solely upon what humans are presently doing. A consideration of settings and interlinked materialities might look at how people are charging their phones in an expanding range of settings, but it might equally consider the automated processes whereby phones communicate with servers and use 3G or WiFi connections to automatically download and install new software. The energy demanded by such processes is part of a major transformation wherein people's activities (in this case continuing to use a functioning phone) are more 'invisibly' supported by doings programmed into their technologies and prompted by new software updates 'pushed' by employees charged with maintaining and developing the device at a distance [53].

Additionally, thinking about how doing-places change over time provides opportunities to reflect upon how the spatio-temporal aspects of practices change. We can observe, for instance, that a large number of doing-places have become increasingly mobile in recent decades due to their anchoring at more mobile objects. Fixed telephone lines and phone boxes have given way to mobile phones (as discussed earlier), and personal computers to laptops and tablets. The possibility of electric vehicles as power sources raises questions of whether even larger appliances might similarly become more mobile. Such transformations have implications for both the energy directly demanded by these anchors, and the energy demanded by associated services (digital connectivity).

Other important transformations relate to how the anchors for doing-places are positioned in objective space. Here there are two developments of particular relevance for energy concerns. In some cases, we can observe a proliferation of doing-places within a particular bounded location – such as more supermarkets being built within a city. This type of transformation increases the possibilities of where (and possibly when) one might shop for groceries, but in so doing also has implications for the energy demanded by keeping these doing-places available to potential customers. In other cases, it is not the demand linked to services and their provisioning that is of concern so much as the energy demand that arises from particular travel-practice sequences. No matter where doing-places are located in objective space, participants must reach them before being able to perform a given practice. Unless the next doing-place that is required happens to be within one's current setting, there is thus a sequencing of first travel to the given doing-place and then performance in it. Changes in how doing-places are arrayed in objective space thus have consequences for the energy demand linked to transportation. For example, the insight that walking the dog is, perhaps counterintuitively, very car dependent [54] highlights that changing expectations and regulations around the practice of walking a dog (e.g. related to the creation of specific off-leash dog parks) can affect the transport (and related energy) demand required to access these doing-paths. As work based upon time-geography approaches has explored [e.g. 55], where doing-places are anchored in objective space can thus be highly consequential for overall levels of transport-related energy demand, and is linked to not only the development or closing of specific services and businesses, but also changing understandings of which

kinds of doing-places are appropriate for a practice (e.g. swimming in indoor heated pools as being preferable and more comfortable than swimming in outdoor bodies of water).

As this section has demonstrated, engaging with Schatzki's concepts of doing-places, settings and anchors provides a vocabulary for considering how dynamics of relational space matter for energy demand. Our discussion has shown that understanding the energy demand linked to practices requires more than a consideration of the objects they involve. It also raises important questions about the dynamics of distributed agency and energy services within varied settings, the energy consequences of keeping doing-places available for practices that may or may not be performed, and how historical changes in the distribution and energy-dependence of doing-places affect opportunities for practices and for changing patterns of energy demand.

Whilst this section has hinted at methodological strategies that might be used to develop these lines of investigation, the next section develops this contribution more explicitly.

4. Exploring methodological implications

Thus far, we have primarily developed the theoretical implications that follow from thinking about energy demand in terms of Schatzki's conceptualisation of relational space. As examples in the previous section highlighted, analysing everyday practices in terms of these concepts has important consequences for how the constitution of energy demand is explained, and therefore what might be done about it. It therefore follows that in order to take these ideas further and explore their value, future empirical work will require new approaches that do not simply replicate established methodologies for studying energy demand and its social and spatial dynamics.

This section therefore more explicitly outlines several methodological principles and procedures that could be embedded in future research. These principles and procedures follow from the theoretical discussion above, and are consistent with its assumptions about the relationship between practices, doing-places and energy demand. In practice, they could serve as multiple possible starting points for creating research designs in which understandings of social practices and relational space are central to how data is generated, how analysis proceeds, and how implications for change are generated. We do not therefore discuss the methods to be used – many methods that have already been shown to effectively gather data on practices might be appropriate [54, 56-59]. In addition, we acknowledge that in any one study determining the most appropriate design must be resolved in relation to the specific research questions being investigated. Nonetheless, identifying a set of principles and matching procedures is a useful device for orienting and potentially re-orienting the specification of such questions in line with the theoretical framework we have worked through.

4.1 Principles and procedures for studying energy demand

1. Practices can have varied and ambivalent relationships with energy demand, therefore research methods and designs should investigate the relationship between doing-places, settings, and their specific manifestations in objective space.

This principle might involve a range of different methodological procedures. One could start from a familiar setting such as the home and then "zoom in" [60] to consider the many doing-places that are anchored within it. Or one could start from a particular practice and its doing-places, then stepping back to explore these in a variety of different settings. Or one could start from a particular anchor to then examine the different practices and settings that it is linked to. In each case, different relations between spaces, practices and energy come to the fore. The aim in building these relationships in methodologically is that it provides a means of keeping in view what can otherwise become backgrounded activities and services, as well as ensuring that energy demand is understood as situated in relational as well as objective space. It also provides the opportunity to discuss the variability of practices and energy demand without presuming *a priori* that this variation is a product of specific infrastructural arrangements or the choices of individual actors.

2. Energy demand arises as a result of distributed agency, therefore research methods and designs should investigate how multiple practices and practice performances are interlinked.

This principle connects to several aspects of the earlier conceptual discussion, with methodologies which analytically bring together multiple sets of practices (and their performances) to create different cuts into energy demand dynamics. Some research has already begun to investigate the interlinked performances of multiple practitioners, for example how the relationship between multiple members of a household, including babies and pets, contributes to the co-constitution of energy demand [61]. Yet there is much more scope to consider not only the performances of those within groups that have already well-established mechanisms of cooperation and coordination, but also those whose sharing of energy services might be more tenuous. Those who use energy services in nondomestic spaces, for example, might share these spaces asynchronously, contributing together to how appropriate levels of service are determined, but never directly interacting or being physically co-present. In such settings, practices involved in provisioning are also evidently important, with energy demand constituted at the intersection between those making use of doing-places (e.g. drinking coffee as a customer) and those making these places appropriate for these doings (e.g. arranging, running and maintaining the café setting). How practices of provisioning respond to, anticipate, plan for, seek to attract and manage the evolving practices that use energy services present challenging dynamics to research, but are a key focus for the study of interrelations between practices, and the phenomena, such as energy demand, that are co-constituted by them.

3. Making doing-places available for an array of *potential* performances of practices can have significant energy consequences, therefore research methods and designs should investigate how the spatial patterning and temporalities of provisioning and use are related.

This principle builds upon the previous one by opening up a number of energy-related considerations in terms of both the local and aggregate consequences of relations between provisioning and use. For example, research designs could trace how the conversion of settings within urban centres from one use to another – in order to add or remove doing-places for particular practices (e.g. the conversion of an office to a restaurant) – has implications for the local patterning of demand (e.g. related to when in the day settings are 'open' and being provisioned in terms of heat and light). In aggregate, such shifts

accumulating around redevelopment or regeneration projects can generate significant pressures on supply infrastructures. Another focus could be on how provisioning is structured by settings being designed to accommodate 'peaks' of multiple synchronous practice performances (which may for example have weekly or seasonal rhythms), and the 'over-capacity' this materially builds into these settings outside of peak periods. Another could be on extensions or realignments of 'opening hours' in response to changing regulations (e.g. around shopping or school days), or as part of processes of competition between those running settings for similar or related practices (e.g. competing pubs for beer drinking), considering how these raise spatio-temporal implications for demand dynamics. For each of these foci, methodologies are needed which focus on the interrelations between patterns of provisioning and use as enacted, designed for, imagined and sought after. Whereas too tight a focus upon how doing-places are used risks over-emphasising the active human doings contributing to energy demand, considering this activity in relation to how energy services are provisioned within settings raises opportunities to discuss how energy demand and occupancy relate.

4. The energy demand associated with interrelated practices, doing-places and settings can change over time, therefore research methods and designs should develop analyses that describe and unpick the consequences of these changing relations in the past but also potentially into the future.

Change has already been a feature of some of the procedures outlined above, but there is value in focusing on it more purposefully. In terms of social space, these concepts emphasise that human activity occurs where it is socially appropriate for it to occur. When thinking about why geographies of everyday practices, and linked energy demand, take particular forms, it is therefore not enough to investigate only the patterns of this activity within objective space. Rather, recognising the historical constitution of practice—doing-place relations – how particular doing-places for practices have developed over time, how widely they are shared, and the consequences for how they are located in objective space – can provide for deeper insights into how demand has come to be in its present form. Similarly, we can imagine research designs that creatively work with shifting relations between practices, anchors, doing-places and settings in order to open up new scenarios for future change. What if key anchoring points for particular energy using practices are reconfigured, becoming for example more fixed or more mobile? What if settings begin to provision for new practice doing-places where they haven't been located before, potentially accumulating doing-places together, or taking them apart? What if established doing-places for existing practices entirely disappear to be replaced by others? Earlier in our discussion we began to discuss how electric cars may play into shifting spatial relations, but scenario development could open up many other cases around very different units of change than are conventionally at the core of scenario specifications. The concepts discussed in this paper therefore provide a useful means of extending existing discussions of practice-focused futures research [62, 63].

As these principles and procedures suggest, there are many different ways that relational space might become a more central feature of research on practices and energy demand. We raise the possibilities above in order to promote reflection and discussion about how methodologies, and not only methods, shape evidence about energy demand and its spatiality.

5. Conclusion

The aim of this paper has been to articulate how more conceptually sophisticated understandings of relational space can be applied to 'demand-side' questions. We have established the basis of a new relational geography of energy demand that provides a range of opportunities for understanding its changing dynamics and patterns. By carefully connecting abstract theoretical concepts with applied examples and outlining four sets of methodological principles and procedures, we have modelled the kind of rigorous yet creative thinking that can too often be skipped over in the race for new empirical insights generated within familiar categories and assumptions - and serving to simply reproduce apparent social realities rather than question them [64]. As we have shown, thinking carefully about how energy demand arises as a consequence of social practices, and how spatialities of practice matter for understanding patterns of energy demand, helps in developing methodologies that could push future research into refreshingly unfamiliar trajectories and explorations.

Conceptually, the framework elaborated in this paper of doing-places for practices, anchoring objects and settings where the doing-places of multiple practices come together and intersect provides a means of bringing understandings of space and place within energy geographies into better alignment both with relational thinking and with the continually evolving social world around us. One of the main outcomes of thinking about space in relational terms is that it foregrounds the contingency and continual, processual production of the spatial, rather than its fixed and static form [3]. Thus, as our examples have demonstrated, the co-production of space and energy demand is also continually on the move rather than stuck in rigid patterns. Practice, space and demand are dynamically intertwined: in the spatially and temporally flexible (and precarious) doing of work, the mobility and immediacy of doing communication as a part of many practices, and the proliferation of opportunities and spaces for forms of consumption. Their configurations have been different in the past and, it follows, will and can be different in the future. The concepts, principles and methodological strategies we have outlined provide an agile set of resources for examining such shifting relationships, as well as for imagining and tracing the steering [65] of their potential trajectories into the future. In this respect, our foregrounding of the shared qualities of doing-places, and the distributed agency and orchestration of energy-derived service provisions provides further openings for seeing that the 'solutions' to problems of excessive or wasteful energy demand do not have to rest solely with individual actions and choices.

Our discussion has not suggested that considerations of objective space must be dismissed – rather given the predominance of concepts based upon conventional and intuitive assumptions of objective space, a robust language for discussing relational space is required in order to ensure that it is not continually measured up to the benchmark of objective space and collapsed back into it [2]. The methodologies and principles outlined above build upon this language to foreground questions about relational space. Whilst they might help to inform different types of research questions and research designs, they also suggest that arriving at a summary of multiple practices and their on-going transformations vis-a-vis relational space will require different procedures than when working with objective spaces, where units, metrics and measures can often be added together or generalised from

in order to provide a ‘bigger picture’. As the examples developed earlier highlight, further exploring relational space will involve carefully considered juxtapositions, comparisons, and sequences that seek to highlight key spatial and temporal processes without oversimplifying their situated detail. In this way, researching how relational space matters for energy demand will itself involve different methodological practices for researchers. This paper thus outlines only a first step for opening up new geographies of energy demand. The development of this and other languages, these and other methodologies will help to address the imbalance of attention between objective and relational space, and more importantly, provide new opportunities for developing a rich evidence base and articulating accompanying strategies for addressing the pressing challenges surrounding energy demand.

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