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PERSPECTIVE

The rhythms and rhythmanalysis of household energy demand

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Abstract

Recent work on energy demand has outlined a series of different factors that determine patterns of energy use and the importance of the social relations that underpin them. Here, we extend calls to recognise that energy consumption is rooted in people's homes and communities by illuminating the significance of rhythms in contemporary patterns of energy demand. We argue that renewed attention on social relations should also focus analysis on the various rhythms and temporalities that influence how people use energy—and how such tempos and contexts change and evolve over time. To do so, we review recent work to outline a framework of how these rhythms and temporalities influence social relations and vice-versa and methods for more holistic understandings of energy demand and potential interventions.

1. Introduction

Our lives follow rhythms. Days are characterised by alarm clocks and habitual mealtimes. Weeks by hobbies and responsibilities. Months by pay checks and the cycle of the moon and years by public holidays and family vacations. These rhythms can also be disrupted as global or national events, changing individual circumstances, evolving household practices, or new technologies necessitate new behaviours. Habits and routines are entangled within household energy demand: our lives' rhythms include switching the lights and heating on earlier as the darkness of winter arrives, cooking family meals to celebrate public holidays, and commutes and school runs leaving the home empty.

Recent scholarship exploring the social science of energy demand draws attention to the importance of social relations to reach a more detailed understanding of how energy demand and consumption are shaped within—and beyond—homes [1, 2]. Social relations represent the affiliations and interactions between people at different social scales [2], forming social structures which can shift and be shifted by energy use patterns [3]. These contributions are significant: illuminating the important relationships between social interactions (and their individual and collective meanings), identities, social relations, and patterns of energy demand. Current policy approaches often fail to make space for such a relational understanding and, instead, characterise household energy demand as following what are deemed 'rational' (or 'irrational') behavioural choices [2]. Policies often expect clear, logical decisions from consumers to be influenced by nudges, incentives, or increased awareness. Such approaches overlook the importance of social and cultural connections and, with them, their rhythms and temporalities.

If social relations are significant to energy demand, the rhythms of how people interact with one another and consume energy matter too. In this intervention, we illuminate how social relations follow distinct—but, often unstable, rhythms: understood as the patterns and tempos that characterise how individuals and households interact with the world around them. It is within these rhythms that decisions affecting energy demand—and the social relations that influence them—take shape. We outline this resonance in three ways: first, in the importance of social rhythms as giving tangible form to social relations; second, in illuminating the temporal instability of such rhythms existing beyond seasons, and third, in highlighting how these

changing rhythms highlight new research methods for understanding energy demand and future interventions.

2. Social relations as rhythms

In exploring the social rhythms and relations of energy demand, we follow recent energy social science literature on social relations within and outside the home. This scholarship includes work exploring the lived experiences of energy initiatives [4], micro-scalar gender relations [5, 6], and importance of domestic relations (family and friendship) [2]. Interaction with groups or organisations at meso (local/community) or macro level (national), shapes energy demand and use patterns [1, 3], as well as involvement in social energy interventions, from warm home schemes to initiatives designed to shift energy behaviours [7]. Social relations can also complicate such approaches: dynamics between private renters and landlords create ‘double incentive’ problems that might restrict household energy improvements. Private renters in multiple occupancy residences [8] have significant implications on domestic energy demand and consumption, where heating and electricity demand can provide important terrains for negotiation tactics, with potential implications on socialisation and relationship dynamics.

These social relations find form in the rhythms of everyday life. Drawing from the work of Gordon Walker, we understand rhythms in energy relations as repeated patterns of demand over fixed timescales (hourly, daily, weekly) [9, 10]. Such social relations and interactions are rooted in temporal processes of change, rhythm and synchronicity [9]. Change through how new contexts and technologies can alter household needs, device efficiencies, and behaviours. Rhythms through dynamics of repeated practices and acts—and synchronicity through how these rhythms might be connected or disconnected to different temporalities (such as the seasons). The ebbs and flows of everyday life enmesh domestic routines (cleaning, cooking, eating, socialising, etc), actors and social structures they form, spaces where actors and practices come together, and temporality, in-built into everyday routines [11].

This builds on the conceptual approach forwarded by Henri Lefebvre that foregrounded daily life in its rhythms. For Lefebvre, ‘everywhere where there is interaction a place, a time, and an expenditure of energy, there is rhythm’ [12, p 15]. These rhythms, inseparable from broader temporalities, highlighted the continued significance of the body and its physicality in understanding social relations and the ‘small details of the everyday’ [13, p 96]. These rhythms would, in turn, become characterised with their interactions and synchronicity with broader cyclical rhythms of days/night, monthly cycles, or seasonal change [12]. In this sense, rhythm is inseparable from temporality: with the rhythms of life and energy demand altering each other within and across years and beyond. For Lefebvre, the study of individual rhythms of everyday life highlighted the points of tension between these daily lives and broader structural pressures associated with the capitalist, consumerist system [12, 14]. This is through how rhythms produce differences in lived experiences: for example, creating different working lives—and, with it, inequalities—for migrant farmworkers in Ontario, Canada [15].

Following Lefebvre’s work, we can understand patterns of energy demand as manifestations of how social relations and rhythms create new moments of energy consumption and peak demand rooted in temporality. Whilst there are individual differences, we do share rhythms of energy demand: most people wake up, go to work, return, and go to bed at similar times [11]. Energy-intensive daily activities and habits (such as showering or heating) are part of everyday routines, often following a regular rhythm. Yet, rhythms, like social relations, are not fixed: changing and being reinscribed with new significance and patterns of behaviour over time. Multiple timeframes and rhythms play out in different ways: for example, monthly financial cycles highlight the importance of financial capacities—with everyday energy use driven by calculations of expenditure and the distance between when income was last and will next be received.

To date, much discussion has been dedicated to how social relations and everyday rhythms coalesce in moments of peak demand through processes of ‘synchronisation’ [16–18]. The ‘family peak’ of household demand is highly coordinated and rooted in routine, becoming a key point where the different rhythms of respective family members coalesce [17]. Such peaks involve different activities that, taken together, form a key moment of household demand—for example: cooking dinner, watching the television, showering and bathing children. Morning routines illustrate a similar process of synchronisation, formed of the use of heating, showers, kettles, lighting and toasters, among other technologies [18]. Whilst based in the confines of the home and, therefore, relatively detached from social relations, this synchronicity is rooted in individual, everyday rhythms occurring—and then repeating and accumulating across neighbourhoods and electricity grids.

This synchronisation of energy demand can also be sporadic and linked to events. Sudden surges of energy demand can be linked to large proportions of a population watching the same television programme

and, using times of commercial breaks to quickly use electrical appliances. In the UK, this ‘TV pickup’ effect—often linked to people switching on a kettle—has overlapped with sports events, soap opera storylines and royal weddings: all of which can create new moments of peak demand [19]. In 1999, a solar eclipse was followed by a record surge of demand in the UK, as workers returned to work having downed tools to watch [20].

In all such cases, social relations and rhythms synchronise to create new moments of demand: as families and friends sit down to eat and witness global events together. These rhythms are regular features of everyday life and provide key moments where social relations take shape and new energy interventions can be developed, co-produced, and targeted to support individual and household change in energy transitions. Whilst there is much discussion of the seasonality of energy demand, these rhythms and touchpoints beyond the home can be understood across different temporalities.

3. Changing rhythms beyond seasonality

The order and disorder of rhythms is uncertain and subject to change. Much policy and media discussion of this temporality highlights the importance of seasonality, with energy demand and, with it, vulnerability to fuel poverty peaking in colder months, for example [21]. Previous work focused has illuminated the ways in which social relations and rhythms become linked in response to environmental factors [22, 23]—hot/cold days, increased rainfall, or longer/shorter days—which amplify the relationships between social relations and energy demand. Colder winters drive domestic heating use, whilst longer summer evenings see demand shift to cooling and outdoor activities. Seasonal traditions, such as Christmas lighting or winter events, create additional peaks of demand. Such seasonality also extend across school terms, university breaks, and holiday seasons—in which household rhythms and energy demand enters new processes of change and synchronisation.

However, a focus on energy rhythms as *seasonal* requires rethinking. This is for several reasons. First, climate change is inducing seasonal change, with different effects in different regions and countries. Severe heat waves are now regular occurrences and, across most of the world, a key energy dilemma faced is the need for cooling—and, with it, new forms of fuel poverty caused by challenge of keeping cool in times of severe heat. Such climate impacts highlight how seasonality is not fixed and, instead, can become less clear and more sporadic when determining future demand.

Second, the temporality of individual and household energy demand is grounded in rhythms across days, weeks and months, as well as the seasons. People move in and out of fuel poverty in/across various timespans and seasonality. Energy vulnerability is not static or inherent [24]. Instead, it can become entangled within other temporalities of everyday life [25]. Recent work has highlighted both the deep temporality of fuel poverty, with some areas experiencing entrenched energy deprivation/affluence over a 10 year period [26]. Others have provided radial graphs of 10 000 people’s everyday activities to show key moments of energy demand [11]. These illustrate a dynamism of energy demand, changing in response to numerous internal and external factors. It is necessary to focus analysis on rhythms that extend beyond seasons of heightened demand. These rhythms as extending beyond seasonality to include daily, weekly, monthly and annual temporalities that require further study.

Many social relations examples driving energy demand rhythms given so far have referred to *daily and weekly rhythms*. These include, for example: food preparation, washing, cleaning, laundry, entertainment, and working practices: all of which represent particular rhythms of everyday energy demand that fall into set times and routines. These elements of routine are not necessarily fixed and can, instead, vary across a week. For example, Torriti has shown how these domestic-based energy rhythms are often more fixed on Tuesdays, Wednesdays and Thursdays—often days with less social interactions [27].

Previous work has highlighted the role of daily and weekly energy rhythms in less-flexible household structures (for example, families with small children) [3, 28]. Other social relations, such as spending communal time together shift energy use habits in households [29, 30]. Daily work or educational cycles affect household energy consumption, creating moments of peak demand (the morning rush, moments when households sit down for dinners) and energy lulls (midday, when more people are out of the home). These habit-forming rhythms can also become implicated in uneven energy relations: with, for example, certain energy-using tasks become rooted in gendered domestic labour [5, 31].

Monthly rhythms extend beyond daily and weekly social interactions and relations to include socio-economic rhythms [32]. Income stream temporality is central to being able to afford timely energy payments, which means, in some cases, added stress/concern for a multitude of groups, beyond traditionally considered vulnerable (young parents, elderly, etc), including temporary workers [33]. Income from employment or welfare payment schemes signal particular moments in monthly financial cycles, affecting financial capacities across weeks and months. Concerns around affordability are expressed through constant

monitoring, shifts in energy use and changing times when energy is used [34]. Coping mechanisms in times of low or insecure incomes, such as borrowing money from friends and family, also have implications on relational dynamics [35]. Understanding these different socio-economic rhythms can support researchers in providing a more nuanced and cross-scalar analysis of daily/weekly energy demand, emphasising the multi-dimensionality and fluidity of everyday life and how changes in energy demand can be both symptoms and causes of household change [36].

Many of these daily, weekly and monthly rhythms shed light on social rhythms beyond the home when understanding energy demand. Energy use occurs across multiple sites involving complex arrays of social relations. The same is true for rhythms, which embody and inscribe existing social networks and neighbourhood-level social relations [1]. These include places where a community might gather (religious centres, sports clubs, libraries), where people with common energy use patterns congregate (school gates), or where more vulnerable people might visit regularly (medical spaces). Interactions in these spaces—in terms of both form and timing—often follow set, regular rhythms. For example, children attend school on given days and at certain times and repeat medical appointments can follow set rhythms dependent on availability. Both highlight an important overlap between the social and the spatial: with temporalities—and their significance—evident in the important site where the rhythms and relationality of energy demand lend physical spaces new meaning in energy relations. Such ‘touchpoints’ of where social relations and rhythms find form in everyday—but repeated—interactions allow the identification of key places of information transfer, awareness building, and in understanding how monthly incomes and affordability can define the accessibility of new technologies, and how such barriers might be overcome.

Annual rhythms are rooted in networks. Engaging with energy efficiency programmes and schemes, for example, is a direct way to improve comfort levels in the home, and potentially lower energy costs. However, engaging with such schemes means, first, finding supporting networks who can facilitate involvement. Recent energy security studies [37], show participants experience energy vulnerability through firstly, conserving utilities and financial means to build up savings to participate, and secondly navigating challenging support systems to access schemes. Social relations play an important role here in establishing status, eligibility and accessing information [4]. For example, identifying local stakeholders and support networks is key to participating in local or national schemes, as shown in the H100 Fife SGN project expanding new hydrogen infrastructure in Scotland, where the energy distribution body built social networks with local Fife residents to shape energy use in their household practice, such as cooking and heating [38].

Focusing attention on these rhythms, rather than on seasonality and environmental factors, allows further interrogation on why and how moments of peak demand occur at times when social relations and interactions become synchronised. Such moments can occur in different ways and magnitudes in the same seasons and building type, fuel mixes and household technologies remain the same across seasons [27]. Change is, instead, often found in the social relations and rhythms that create new patterns of demand across days, weeks, or months. These rhythms overlap in complementary and contradictory ways, highlighting key points of tension within households and potential restrictions on how people interact with their broader social networks and communities.

Whilst these rhythms represent changing dynamics across different temporalities, they will also be subject to further change and disruption in the future. It is necessary for research to understand these new forms of disruption, rupture, and change within future energy transitions.

4. Rhythm-breakers as defining new research methods for energy transitions

We understand rhythms as creating new conditions for future social science research exploring energy transitions due to how they change the ‘forms’ (the tangibility, measurability, or qualitative experiences) of energy demand. Such approaches can support greater understanding of the important social factors that determine moments of peak demand.

Changing rhythms highlight a need to understand household behaviours as about both adapting to new conditions and how such new rhythms are integrated and resisted in everyday life [39]. Decarbonisation and electrification of our energy systems requires a making of new rhythms of life, interaction, and energy supply and demand [10]. Existing rhythms will be disrupted and realigned: evident in shifts to electric vehicles (and their charging apparatus) and the emergence of new technologies that monitor demand and highlight new points of flexibility. Walker has labelled these new technologies as ‘rhythm-linkers’ (i.e. thermostats), ‘rhythm-revealers’ (smart metres) and ‘rhythm-smoothers’ (batteries): all highlighting patterns of household energy demand and flexibility to individuals, families, and energy suppliers [10, p 122]. The transition from cooking with solid-fuel stoves to electric can both reduce indoor air pollution and carbon emissions, whilst also developing new domestic rhythms as time and capacity is freed up for dedication elsewhere [40]. Elsewhere, the further increased popularity of electric vehicles can create new moments of synchronisation of

energy demand and, with it, pressures on the national grid (likely overlapping with existing moments of high demand as people return home).

Rhythms interact, coalesce, or disrupt one another. Life is ‘polyrhythmic’, with multiple rhythms interacting in the same space: whilst some synchronise (labelled by Lefebvre as ‘eurhythmia’), others lead to disorder (‘arrhythmia’) [12, p 16]. In Walker’s typology, changing household rhythms are primarily in response to new technologies. However, change can also be found in moments of rupture: or events—both positive and negative, planned and unplanned, and multi-scalar—that trigger people and households to reconfigure their everyday lives, relations and rhythms to adapt [39, 41].

To follow Walker’s typology, these ‘rhythm-breakers’ can occur at different scales. At the household level, job loss or change can create new income dynamics that require reduced use or lead to new forms of energy demand, and moving to shift work can lead to new moments of peak demand. Illness or injury can lead to new requirements for at-home medical equipment or mobility aids. Family size is also open to change: through childbirth, relationship breakdown, or bereavement.

At the neighbourhood level, broken rhythms can be driven by energy crises (such as household disconnections or grid instability), extreme weather events and climate hazards, new housing developments creating new social relations in close proximity, or business closure reducing commuting or use of third-party sites for leisure or socialising.

Household and neighbourhood rhythms of energy demand are also influenced by national and global events. Economic recessions and rising costs of living can lead to households reducing their energy demand—both through reducing the use of technologies and heating but also through increased energy efficiency measures [42]. Beyond this, experiences of the COVID-19 pandemic highlight how rhythms of energy demand can be disrupted in a short timeframe. In the UK, government restrictions on movement led to increased domestic electricity and heating demand [43] and new synchronised surges of energy demand [44]. Since then, changing working practices—such as people working from home—will have further altered household energy rhythms.

New enablers or restrictions on energy demand can affect the materiality of everyday life, leading to a series of destabilising changes of daily rhythms [45]. Whilst new energy technologies might support some load-shifting and change behaviours, it also necessitates new forms of work (i.e. monitoring, ‘prosuming’) that, in turn, creates new rhythms of behaviour that may reinforce gendered divisions of domestic labour or create new inter-household relations, tensions, and conflicts [46–48]. Energy price rises in the UK led to numerous people withdrawing from social networks and events, spending more time in homes that were colder [49]: a ‘rupture’ to rhythms is not necessarily a positive experience and can create new limitations on how energy support can reach individuals.

An analytical focus on rhythms requires research approaches centred on the body and the embodied drivers and barriers to energy use—and the personal, physical benefits of use and impacts of its absence. Many of the above moments of rhythms breaking have deeply personal characteristics. Childbirth, bereavement, separation, illness are all significant moments in a person’s life. National and global events have psychological and embodied consequences for all affected. Whilst policy interventions can focus on energy in units of kilowatts and hours of use or peak demand, a language of rhythms broadens this to include the ‘vitality’ or ‘life force’ that such energy demand may provide and embody in everyday lives and household. A light turned on is not exclusively an increase in kilowatt/hour—it can also represent safety through a night-light switched on to help a child sleep.

Energy research and policy will benefit from paying greater attention to these rhythms to make sense of recent processes of change in practices of energy demand, how they are linked to social relations, and how new interventions can be devised and evaluated to support households reduce or make crucial shifts in their demand in the future.

5. Future directions

Rhythms of energy demand illuminate new routes of understanding, devising and evaluating interventions through revealing the importance of the sub-conscious, the habitual, and the everyday. Yet, they also highlight a potential blind spot in contemporary approaches. Smart home energy systems are often crafted by professionals whose perspectives and conceptualisations of these technologies are shaped by their personal experiences and assumptions [50]. A limited understanding of the diverse rhythms of energy use across different communities, may result in significant inequalities as designers may unconsciously interpret other users’ energy patterns through the lens of their own background, social relations and rhythms of demand.

This *Perspective* piece is an intervention to illuminate the significance of energy rhythms beyond seasonal changes. More work is needed to understand these moments of synchronised rhythms and demand, both within a household and beyond, and they create new moments of peak demand. Whilst Lefebvre devised a

conceptual approach of rhythmanalysis to explore the rhythms of everyday life—particularly in understanding rhythms in urban space and how it is experienced; he did not leave a clear methodological approach to doing so [12]. There is a not ‘a single off-the-shelf method’ for conducting rhythmanalysis [51, p 103]: a range of methodologies have been adopted, from the analysis of social media use [52], archival work [53], reflective diaries [54], and micro-ethnographies [55].

In recent work, Gordon Walker positions rhythmanalysis as beyond a methodological approach and, instead, opening up space to illuminate different ways of knowing and understanding energy relations [10]. Work in cultural geography has deployed the approach in studies of tourism, nightlife, and working lives [56–58]. Others have deployed walking methodologies to explore rhythms of urban space and bodily responses to it or digital methods to understand the natural, social rhythms of the authors’ own working lives [59, 60]. Elsewhere, energy rhythms have been explored using qualitative interviews and electricity metre data to understand household routes to demand flexibility.

These methods signal the importance of qualitative approaches in understanding these links between social relations and rhythms: and how they might be broken or altered by new events. Adopting such methodological approaches in energy social science research will allow closer analytical attention to the rhythms of consumption and need beyond seasonal patterns, allowing future work to illuminate new forms of social relations and energy demand. Recent work has adopted diary methodologies to understand how understand links between social activities (labelled as ‘sociability’) and household energy consumption—highlighting how behaviours adapt to different contexts (in this case the UK COVID-19 lockdown) [61]. Such approaches—focused on rhythms of everyday and working lives—may allow research processes to be inclusive, inter-sectional and justice-led: working with marginalised groups to understand their daily lives on their own terms [15]. There remains a need to understand how such activities take personal, subjective, emotive meanings for people as they are repeated, emphasised, and disrupted across different timescales and contexts. It is within these qualitative perspectives that rhythms of energy demand take new significance and create new moments for intervention in energy transitions policy.

This highlights several spaces for intervention in energy demand management. Demand flexibility approaches can help people—but there needs to be more work done to understand how they might fit into (or ‘break’) existing daily rhythms of energy demand and use. Other policies might focus on disrupting entrenched rhythms of energy: such as through the promotion of off-peak energy use. Households may also be classified into archetypes based on their energy rhythms, with interventions moving beyond ‘energy-saving tips’ and tailored to support small adjustment in existing routines. These rhythms of energy demand, social relations, and the individual–community touchpoints that enable or complicate them should be of interest to researchers working on—and towards—new grid flexibility. As the rhythms of everyday life change, demand flexibility approaches can support households in aligning or flexing new energy behaviours with changing daily, weekly, monthly and annual rhythms. Paradoxes might emerge—increasing work-from-home practices for some will increase day-time demand, whilst more-varied household schedules will create more distributed use. A wholesale transition to electric vehicles will create new demands: likely leading to increased evening peaks as electric vehicle charging beings after returning home: leading to ‘smart’ chargers prioritising off-peak charging.

The increased adoption of renewables in the energy mix is expected to introduce greater variability in energy production, thereby necessitating more flexibility in domestic consumption patterns. In particular, researchers must remain cognisant of how these rhythms alter the touchpoints of where individualised rhythms overlap with community social relations. Smart device coordination could provide more opportunities to synchronised energy management at the neighbourhood level, balancing grid load and providing new routes for community energy ownership.

Central to any new approach must be a focus on the granular, the everyday, even the mundane. The movement of rhythmanalysis from a conceptual approach towards a tangible research approach can broaden contemporary understandings of relationality of energy demand—and how everyday life can provide new spaces for support. Energy transitions are entangled with the rhythms of energy demand in everyday, habitual and often-mundane ways. They will alter existing and create new rhythms and the potential shape and success of the transitions themselves will be defined by the ease at which people might shift peak moments of demand. Energy social science research must pay more attention to these rhythms and how they complicate, expand and illuminate new routes of analysis.

Data availability statement

The data that support the findings of this study are available upon reasonable request from the authors.

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References

- [1] Hargreaves T and Middlemiss L 2020 The importance of social relations in shaping energy demand *Nat. Energy* **5** 195–201
- [2] Middlemiss L, Davis M, Brown D, Bookbinder R, Cairns I, Minini G M, Brisbois M C, Hannon M, Owen A and Hall S 2024 Developing a relational approach to energy demand: a methodological and conceptual guide *Energy Res. Soc. Sci.* **110** 103441
- [3] Oliveira S, Chatzimichali A, Atkins E, Badarnah L and Moghaddam F B 2023 From individuals to collectives in energy systems—a social practice, identity and rhythm inspired lens *Energy Res. Soc. Sci.* **105** 103279
- [4] Snell C, Bevan M and Thomson H 2015 Justice, fuel poverty and disabled people in England *Energy Res. Soc. Sci.* **10** 123–32
- [5] Standal K, Talevi M and Westskog H 2020 Engaging men and women in energy production in Norway and the United Kingdom: the significance of social practices and gender relations *Energy Res. Soc. Sci.* **60** 101338
- [6] Strengers Y 2023 Resource man and the smart wife: implications for sustainability in the home *Interactions* **30** 36–40
- [7] Southerton D, McMeekin A and Evans D 2011 *International Review of Behaviour Change Initiatives* (Scottish Government)
- [8] Bouzarovski S and Cauvain J 2016 Spaces of exception: governing fuel poverty in England's multiple occupancy housing sector *Space Polity* **20** 310–29
- [9] Walker G 2014 The dynamics of energy demand: change, rhythm and synchronicity *Energy Res. Soc. Sci.* **1** 49–55
- [10] Walker G 2021 *Energy and Rhythm: Rhythmanalysis for a Low Carbon Future* (Rowman & Littlefield)
- [11] Lord C, Shove E and Blue S 2022 The timing of energy demand: daily, weekly and annual patterns of activities and how they connect (CREDS Energy Flexibility Gallery) (available at: <https://wp.lancs.ac.uk/energyflexibilitygallery/the-timing-of-energy-demand-daily-weekly-and-annual-patterns-of-activities-and-how-they-connect/>) (Accessed 14 October 2024)
- [12] Lefebvre H 1992 2004 *Rhythmanalysis: Space, Time and Everyday Life* (Continuum)
- [13] Elden S 2004 *Understanding Henri Lefebvre: Theory and the Possible* (Continuum)
- [14] Lefebvre H 1981 [2014] *Critique of Everyday Life* (Verso)
- [15] Reid-Musson E 2018 Intersectional rhythmanalysis: power, rhythm, and everyday life *Prog. Hum. Geogr.* **42** 881–97
- [16] Ramirez-Mendiola J L, Mattioli G, Anable J and Torriti J 2022 I'm coming home (to charge): the relation between commuting practices and peak energy demand in the United Kingdom *Energy Res. Soc. Sci.* **88** 102502
- [17] Nicholls L and Strengers Y 2015 Peak demand and the 'family peak' period in Australia: understanding practice (in) flexibility in households with children *Energy Res. Soc. Sci.* **9** 116–24
- [18] Torriti J, Hanna R, Anderson B, Yeboah G and Druckman A 2015 Peak residential electricity demand and social practices: deriving flexibility and greenhouse gas intensities from time use and locational data *Indoor Built. Environ.* **24** 891–912
- [19] Drax 2022 7 of the biggest TV moments in UK electricity history: Drax, Drax Global (available at: www.drax.com/power-generation/9-of-the-biggest-tv-moments-in-uk-electricity-history/) (Accessed 07 February 2025)
- [20] BBC NEWS n.d. Science/nature | specials | total eclipse | eclipse sparks record power surge (available at: http://news.bbc.co.uk/1/hi/sci/tech/specials/total_eclipse/417650.stm)
- [21] Alonso C, De Frutos F, Martín-Consuegra F, Oteiza I and Frutos B 2024 Energy consumption and environmental parameters in Madrid social housing. Performance in the face of extreme weather events *Build. Environ.* **254** 111354
- [22] Liu Y 2016 Seasonal relationship of peak demand and energy impacts of energy efficiency measures—a review of evidence in the electric energy efficiency programmes *Energy Effic.* **9** 1015–35
- [23] Clements M P and Madlener R 1999 Seasonality, cointegration, and forecasting UK residential energy demand *Scottish J. Polit. Econ.* **46** 185–206
- [24] Simcock N, Jenkins K E H, Lacey-Barnacle M, Martiskainen M, Mattioli G and Hopkins D 2021 Identifying double energy vulnerability: a systematic and narrative review of groups at-risk of energy and transport poverty in the global north *Energy Res. Soc. Sci.* **82** 102351
- [25] Blue S, Shove E and Forman P 2020 Conceptualising flexibility: challenging representations of time and society in the energy sector *Time Soc.* **29** 923–44
- [26] Bridgen P and Robinson C 2023 A decade of fuel poverty in England: a spatio-temporal analysis of needs-based targeting of domestic energy efficiency obligations *Energy Res. Soc. Sci.* **101** 103139
- [27] Torriti J 2017 Understanding the timing of energy demand through time use data: time of the day dependence of social practices *Energy Res. Soc. Sci.* **25** 37–47
- [28] Numminen S, Kajoskoski T, Kaltampanidis Y and Jalas M 2024 Energy vulnerability of detached home owners in Finland: an explorative study *Energy Build.* **310** 114082
- [29] Hill E J, Ferris M and Martinson V 2003 Does it matter where you work? A comparison of how three work venues (traditional office, virtual office, and home office) influence aspects of work and personal/family life *J. Vocat. Behav.* **63** 220–41
- [30] Wang Y, Hou L, Hu L, Cai W, Wang L, Dai C and Chen J 2023 How family structure type affects household energy consumption: a heterogeneous study based on Chinese household evidence *Energy* **284** 129313
- [31] Strengers Y and Kennedy J 2020 *The Smart Wife: Why Siri, Alexa and Other Smart Home Devices Need a Feminist Reboot* (The MIT Press)

- [32] Middlemiss L and Gillard R 2015 Fuel poverty from the bottom-up: characterising household energy vulnerability through the lived experience of the fuel poor *Energy Res. Soc. Sci.* **6** 146–54
- [33] Willand N, Torabi N and Horne R 2023 Recognition justice in Australia: hidden energy vulnerability through the experiences of intermediaries *Energy Res. Soc. Sci.* **98** 103013
- [34] Groves C, Shirani F, Pidgeon N, Cherry C, Thomas G, Roberts E and Henwood K 2020 ‘The bills are a brick wall’: narratives of energy vulnerability, poverty and adaptation in South Wales *Energy Res. Soc. Sci.* **70** 101777
- [35] Anderson W, White V and Finney A 2012 Coping with low incomes and cold homes *Energy Policy* **49** 40–52
- [36] Gillard R, Snell C and Bevan M 2017 Advancing an energy justice perspective of fuel poverty: household vulnerability and domestic retrofit policy in the United Kingdom *Energy Res. Soc. Sci.* **29** 53–61
- [37] Simes M, Rahman T and Hernández D 2023 Vigilant conservation: how energy insecure households navigate cumulative and administrative burdens *Energy Res. Soc. Sci.* **101** 103092
- [38] SGN 2024 H100 Fife—a world-first green hydrogen-to-homes heating network on the Fife coast (available at: www.sgn.co.uk/H100Fife) (Accessed 03 December 2024)
- [39] Awad S H 2021 Experiencing change: rhythms of everyday life between continuities and disruptions *Qual. Stud.* **6** 85–107
- [40] Rao D N and Sagar A D 2024 Electric cooking as a clean and just energy solution *Nat. Rev. Earth Environ.* **5** 751–2
- [41] Zittoun T 2009 Dynamics of life-course transitions: a methodological reflection *Dynamic Process Methodology in the Social and Developmental Sciences* ed J Valsiner, P C M Molenaar, M C D P Lyra and N Chaudhary (Springer)
- [42] Atkins G, Lockwood M, Britton J and Hoggett R, 2023 *Testimonies from the energy crisis: understanding energy vulnerability in the UK* (Policy Bristol) (available at: www.bristol.ac.uk/media-library/sites/policybristol/policy-projects/Atkins%20et%20al%202023_Testimonies%20from%20the%20Energy%20Crisis.pdf) (Accessed 10 February 2025)
- [43] Zapata-Webborn E, McKenna E, Pullinger M, Cheshire C, Masters H, Whittaker A, Few J, Elam S and Oreszczyn T 2023 The impact of COVID-19 on household energy consumption in England and Wales from April 2020 to March 2022 *Energy Build.* **297** 113428
- [44] NESO Energy n.d. Lockdown effect: TV viewing habits and electricity grid (available at: www.neso.energy/news/lockdown-effect-tv-viewing-habits-and-electricity-grid) (Accessed 7 February 2025)
- [45] Paiva D 2016 Collapsed rhythms: the impact of urban change in the everyday life of elders *Space Culture* **19** 345–60
- [46] Korsnes M and Throndsen W 2021 Smart energy prosumers in Norway: critical reflections on implications for participation and everyday life *J. Cleaner Prod.* **306** 127273
- [47] Martin R 2022 Energy housekeeping: intersections of gender, domestic labour and technologies *Build. Cities* **3** 554–69
- [48] Furszyfer Del Rio D D 2022 Smart but unfriendly: connected home products as enablers of conflict *Technol. Soc.* **68** 101808
- [49] Atkins E, Robinson C, Davies S, Collard S and Copeland M 2023 *Testimonies from the energy crisis low income households’ experiences of paying for energy in a cost of living crisis* (Policy Bristol) (available at: www.bristol.ac.uk/policybristol/policy-engagement-projects/testimonies-energy-crisis/) (Accessed 03 December 2024)
- [50] Pereira V J and Hargreaves T 2024 Are you thinking what I’m thinking? The role of professionals’ imaginaries in the development of smart home technologies *Futures* **163** 103458
- [51] Lyon D 2018 *What Is Rhythmanalysis?* (Bloomsbury Academic)
- [52] Yokotani K and Takano M 2021 Social rhythms measured via social media use for predicting psychiatric symptoms *APSIPA Trans. Signal Inf. Process.* **10** e16
- [53] Chin Y 2016 *Practice Rhythmanalysis: Theories and Methodologies* (Rowman and Littlefield)
- [54] Bennett J 2015 ‘Snowed in!’: offbeat rhythms and belonging as everyday practice *Sociology* **49** 955–69
- [55] Lyon D and Coleman R 2023 Rupture, repetition, and new rhythms for pandemic times: mass observation, everyday life, and COVID-19 *History Hum. Sci.* **36** 26–48
- [56] Jones P and Warren S 2016 Time, rhythm and the creative economy *Trans. Inst. Br. Geogr.* **41** 286–96
- [57] Edensor T and Holloway J 2008 Rhythmanalysing the coach tour: the ring of Kerry Ireland *Trans. Inst. British Geogr.* **33** 483–501
- [58] Schwanen T, Van Aalst I, Brands J and Timan T 2012 Rhythms of the night: spatiotemporal inequalities in the nighttime economy *Environ. Plan. A* **44** 2064–85
- [59] Nash L 2020 Performing place: a rhythmanalysis of the City of London *Org. Stud.* **41** 301–21
- [60] Pitts F H, Jean E and Clarke Y 2020 Sonifying the quantified self: rhythmanalysis and performance research in and against the reduction of life-time to labour-time *Capital Class* **44** 219–39
- [61] Davies S R, Lupton R C and Allwood J M 2024 How energy demand and wellbeing change as we use our time differently *Energy Policy* **189** 114115