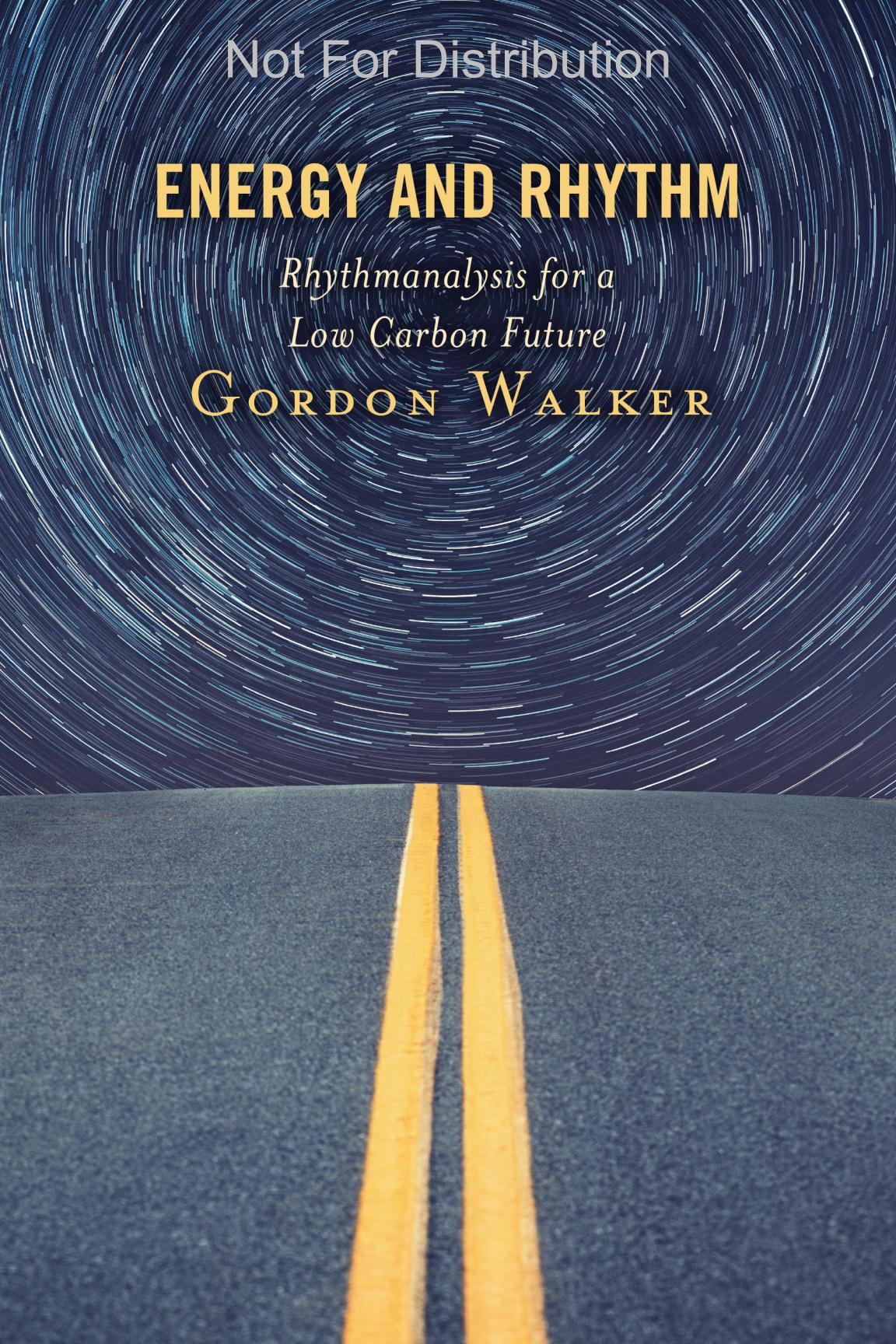


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ENERGY AND RHYTHM

*Rhythmanalysis for a
Low Carbon Future*

GORDON WALKER



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Energy and Rhythm

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Rhythmanalysis for a Low Carbon Future

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Acknowledgments

I finished this book in May 2020, whilst in lockdown due to the Covid-19 virus. I decided not to write this experience into completing the text. Readers may, though, find themselves reflecting on how the normal anticipations of repeating, interwoven rhythms of economy and society, places and everyday lives were starkly revealed by their prolonged interruption. Breaking with the normal order of things was vital, but much later than it should have been and undermined by arrogance and incompetence.

I started the book two years earlier, after experimenting with the ideas in various ambitiously rhythmic presentations at conferences, seminars and invited talks. I am indebted to many people along the way, including those collaborating in research projects that feature in the book. These include many colleagues in the Dynamics of Energy, Mobility and Demand (DEMAND) Centre, which ran from 2013–2019, namely Allison Hui, Mette Kragh-Furbo, Nicola Spurling, Rosie Day, Neil Simcock, Rose Chard, Stanley Blue, Sylvie Douzou, Catherine Grand-Clement, Elizabeth Shove, Frank Trentmann, Russell Hitchings, Mathieu Durand-Daubin, Gregoire Wallenborn, Giulio Mattioli, Greg Marsden, Janine Morley, Jacopo Torriti, Mitchell Curtis, Ben Anderson, Iain Goddard, Mike Allen and Torik Holmes. Visitors to the Centre and its event programme also shaped my thinking, including Conor Harrison, Yolande Strengers, Mikko Jalas, Tim Schwanen, Mikkel Bille, Anthony Levanda and Alan Wiig, as did opportunities to interact with Ralph Horne, Cecily Maller and others while at RMIT in Melbourne. Working specifically on rhythm with Elspeth Oppermann produced a paper in *Geoforum* on thermal rhythmanalysis in the context of climate change, which is referred to in various places in the book. Her insight and enthusiasm for rhythm-thinking were enormously motivating, as were comments made on chapter 3 of this book when I was unsure of where it was going.

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This book is dedicated to my mum, who knew a thing or two about keeping the rhythms of family life and caring for others in good order.

A website with resources supporting this book is available at
<http://wp.lancs.ac.uk/energyandrhythm/>.

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Chapter One

Introduction

Energy and Rhythm Together

The turbine cycles. The train moves. The modem flashes. The lift rises. The tide surges. The wheel rotates. The light flares. The sun rises. The chest falls. The blood pulses. The leaf opens. The fire burns. The sky darkens. The room warms. The storm rages. The waters rise. The wind blows. The klaxon sounds. The day begins. The meal finishes. The lights dim. The boiler switches. The car roars. The cold freezes. The turbine cycles.

All energy. All rhythm.

There were two catalysts for writing this book. Whilst working in a social science-led multidisciplinary research centre focused on the dynamics of energy demand,¹ I was encouraged by colleagues to engage with rhythmanalysis as conceived by Henri Lefebvre, writing by himself and jointly with Catherine Régulier. As a human geographer, I was already sensitized to its distinctive spatiotemporal approach to understanding the polyrhythmic dynamics of cities and other social phenomena. However, I was not expecting to find energy in its definition of rhythm as space, time *and* energy in interaction, something that has been ignored by pretty much all of the body of rhythmanalytic work that has followed. Having become intrigued, the second catalyst was finding myself thinking about both the rhythms and the energy flows that were around me, which I was immersed in and that were animating the moments and worlds I was inhabiting. As in the list of things and verbs that opens this chapter, I found myself enumerating ways in which rhythms were energetic, and energies were rhythmic. And the more I engaged with the vastly open scope of the rhythmanalytic project, the more I found things to be said about the interrelations between energy, rhythm and carbon. In the second line of

1. The Dynamics of Energy Demand Research Centre; see www.demand.ac.uk.

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Lefebvre's ([1992] 2004: 13) main rhythmanalysis essay, he proposes 'nothing less than to found a new science, a new field of knowledge: the analysis of rhythms; with practical consequences'. What more urgent 'practical consequences' to engage with than the current and future climate crisis?

In this book, I make the case for bringing energy and rhythm together. I argue that rhythmanalysis, if worked with in a flexible way, as heuristic rather than fixed method, drawing on a diversity of forms of knowledge from sciences and social sciences, has something distinctive and significant to add to the study of energy in the context of climate change and low carbon transition. A rhythmanalytic view makes clear that time and temporalities matter to stripping carbon out of energy systems. Not just in the sense of timescales of transition and speeds of change (Sovacool 2016), but also in the very substance of how energy systems work and how they are integral to the ongoing structure and order of societies. This means that it is rhythms *in* transition that matter to low carbon futures, not just the temporalities and rhythms *of* transition. Rhythms transitioning both within and beyond energy system boundaries, rhythms in energy resources, in working technologies, in everyday activity, in infrastructures, homes, bodies and cities, in energy supply and in energy demand. Rhythmanalysis provides a framework for an integrative analysis across wildly different rhythmic phenomena, and, in this book, for applying this to understanding how rhythms and their energies interact, combine, synchronize, beat together and evolve. This all adds up to a novel, constantly dynamic way of seeing and unpacking the challenges of decarbonisation and, what I will later call, de-energisation, in response to the urgent and potentially existential threat of climatic change.

Working with rhythmanalysis also makes very clear the need to go beyond the social and technological in understanding the fundamental energetic condition in which current climate concerns are embedded. For all the attention to we give to 'techno-energies' within wires, cables, pipes and tanks, there are also energies in atmospheres, in ecologies, in organisms and biologies that are foundational to the planet and the bodies we inhabit. For some disciplines, such an understanding is very basic and fundamental, but in the social sciences we can become so wrapped up in 'the social' that boundaries are drawn that are not at all helpful when energies and rhythms are busy pulsing, flowing and interacting across them. As a geographer, I have always been sensitised to the importance of engaging between 'the social' and 'the natural', between the human and the physical, and rhythmanalysis has a vastly untapped potential for so doing.

These are the arguments that will emerge from bringing energy and rhythm together, step-by-step, through the rest of the book. In this introductory chapter, I will outline in streamlined terms the building blocks and the structure

of the chapters that follow, before considering matters of geographical scope and different ways of reading the book that might be adopted.

RHYTHM

Think of a rhythm. Any rhythm. Rhythms proliferate around us, in us. Maybe you thought of your heartbeat, or the rhythm of working and not working (a more complicated rhythm than it used to be), or the seasonal rhythms of spring, summer, autumn and winter (also, some would say, more complicated than they used to be). Or maybe the rhythm of music, of walking, of traffic lights, your washing machine, your tea drinking, Christmas celebrations, day and night, birdcall, the tides. Start thinking rhythmically and it is easy to keep going and difficult to know when to stop. We expect rhythmic repetitions, anticipate them, rely on them to keep going and provide some order to what comes next, tomorrow, next year; while knowing that even ‘Groundhog Days’ never repeat exactly, but with some degree of difference, unrealised expectation or surprise.

Repeating rhythms proliferate in their multiplicity as well as ubiquity, and all these rhythms, with their different beats and pulses, regularities and irregularities, forms, shapes and measures, do not exist in isolation. They coexist with others, they interweave and interact, they interconnect—they are ‘inter’ in various ways—forming *polyrhythmia* of diverse rhythms that run through your body, your everyday, the places you inhabit, the world that you live in, and live on. Contemplate the notion of biorhythms, or the ‘circadian clock’, and your corporeal rhythms become interconnected to the rhythms of the galaxy and its cyclical making of planetary day and night. Insert the sudden but timetabled rhythm of a flight to the other side of the world, and a certain rhythmic chaos enters into this interconnection in the form of jet lag to be managed, and rhythms of sleeping and eating to be re-established. Rhythms interconnected, interwoven, in bundles or *polyrhythmia* that are dynamic and open to change, and both human-made and beyond the intentionality of human action (see figure 1.1).

For Lefebvre ([1992] 2004: 28), ‘the study of rhythms covers an immense area; from the most natural (physiological, biological) to the most sophisticated’. As discussed in chapter 2, he is not the only theorist who has engaged with seeing and analysing the world rhythmically, but he is alone in offering an account of rhythm that spans the vastness of the cosmos to the intimacy of the human body and a creative and open inspiration for analysing rhythms through diverse multidisciplinary ways of knowing. The work of other rhythm and time-engaged theorists will come and go in what follows, but, as

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Figure 1.1. The rhythms of seasons, ecology, sunlight and air travel.

Photo by the author.

will become clear, Lefebvre's final book published posthumously, and based on ideas developed in earlier writing, including with Régulier (Lefebvre and Régulier [1985] 2004, [1986] 2004), will feature throughout as a touchstone and central orientation.

The task he, and they, set out is strikingly ambitious. Rhythmanalysis both puts forward a rhythmic ontology and the beginning of a methodology (Lyon 2018). Rhythm animates, there is 'nothing inert in the world' (Lefebvre [1992] 2004: 26), with the rhythmanalyst recognising representations (of many different disciplinary forms) by their 'curves, phases, periods and recurrences' (*ibid.*: 32). Seeing the world rhythmically is therefore an analytical process, something that I—in the sensing and thinking that I do, the data I draw on, and the words that I write—am actively engaged in undertaking and creating. In this book, I will not be following a set, step-by-step analytical method, and, as explained in chapter 2, I will not 'do' rhythmanalysis in an entirely conventional way. Rather, in taking inspiration from Lefebvre, and from others that have been similarly inspired, I will work with a rhythmic vocabulary, move across temporal and spatial scales, and deploy various tactics in order to attempt to capture the complexities of the rhythms and energies that the book is concerned with.

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The product of one particular tactic will be found in the set of rhythm-energetic vignettes that are located in text boxes throughout the following chapters. These follow in their spirit, Lefebvre's evocative account of sitting in his apartment in Paris and observing the multiple interweaving rhythms of the city square below through the different phases and movements of the day. I will use this style of writing to evoke the multiple rhythms of different settings (at home, on the move, inside, outside) in which I have lingered and, in Lefebvre's terms, sought to (*ibid.*: 20) '*listen to the world . . . in which nothing is immobile*', also giving attention in various terms to the energies that are simultaneously in circulation.

ENERGY

So what about energy? Return again to the rhythms you thought about. They all involve energy, energy expenditures, energy flows or transformations, although some more obviously than others. The beating of your heart, the pulsing of your heart muscle, is an expenditure of the stores of energy in your body accumulated from the food that you eat; its generated movement, its rhythm is an expenditure of energy at a moment in time and in a particular space. The energy in the rhythm of a traffic light or washing machine is self-evident; the traffic light only pulses and the washing machine drum only circles if electricity provides the power and is used (and expended) to make those rhythmic movements, in those specific technologies. How about seasonal rhythms? That is a more abstract notion of a rhythm, but has at its foundation a cyclical annual variation in the solar energy received on part of the earth's surface, which then, in interaction with many other rhythms, shifts the weather conditions we experience and the ecologies that we see around us and live with. The seasons are about far more than energy, but they can be understood as energetic in their rhythmic returning manifestation and constitution.

We could work through the energy in many other examples of rhythms, and in chapter 3 there is much that will be explained in order to more precisely consider how energy and rhythm are related. For the moment, the general argument is that in thinking rhythmically we can also simultaneously think energetically, and therefore engage with how everyday life is run through with rhythmically structured and interconnecting flows of energy; both 'natural' and 'techno-energetic' to use a distinction that is deployed through the book. To grapple with energies (the plural being important) in such ubiquitous and varied forms (calories, electricity, solar radiation, heat, light), is to take on how physicists and others in various scientific fields understand energy through thermodynamics as a general concept; as the only 'universal

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currency', to use Smil's (2017: 1) phrase. It is also, I will argue in chapter 3, a way of making sense of energy being located in Lefebvre's definition of rhythm, in which space, time and energy interact, to quote 'everywhere where there is interaction between a place, a time and an expenditure of energy there is rhythm' (Lefebvre [1992] 2004: 15). My reasoning will require some justification as Lefebvre does not explain what meaning he is giving to energy, a word with multiple interpretations (Rupp 2013), but for me this opens up a productive space for exploring how to 'energise' rhythmanalysis through a thermodynamic interpretation.

To guard against misunderstanding even at this preliminary stage, my intention is not to reductively insist that rhythms can only be properly understood through their 'expenditure of energy'. As I will reiterate in chapter 3 and elsewhere in the book, rhythms are energetically constituted only in their *physical* manifestation. Rhythms have all sorts of quantities, qualities and meanings and can be understood and articulated through different knowledge systems, including those that see rhythm in a more figurative or symbolic sense (rhythms of thought or of artistic expression, for example). Rhythms can be imagined, anticipated and remembered and have consequences in taking such 'virtual' forms. Particular energies interacting in space and time can also be incidental to the rhythms that analysts are interested in understanding, therefore meriting little attention. However, for my purpose, recognising the energy in all (physical) rhythm is to establish a distinctive foothold in engaging with contemporary energy and climate concerns (climate change itself being a thermodynamic and rhythmic phenomenon), and for foregrounding the study of some particularly energetically significant rhythms over others, and some specifically energetic processes through which rhythms interact and interconnect.

ENERGY, RHYTHM AND CHANGE

Humans from their very origins have lived with and through the animations and dynamics of rhythms and energies, but as new forms of intentional energy conversion and making of energy services (from the warmth and illumination of wood fires, to the speed and excess of private jet planes) have been added into the mix, consequences have followed for how rhythms and energies are interrelated. Lefebvre captures something of these historical dynamics in this mechanical imagery of motion, power and hidden energy:

society underwent something that recalls the great changes in communications. It saw cylinders, pistons and steam jets: it saw the machine start up, pull, work and move. Electric locomotives only present to the eye a big box that contains

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and conceals the machinery. One sees them start up, pull and move forward, but how? The electrical wire and the pole that runs alongside it say nothing about the energy that they transmit (Lefebvre [1992] 2004: 24).

Beyond such glimpses, there is no systematic analysis of how the interlacing of rhythmic and energetic change has come about and had consequence. Elsewhere there are histories of time-keeping, of time systems and, to some degree, of socio-rhythmic change (Adam 1990, Birth 2012, May and Thrift 2001, Zerubavel 1981, 1985), and there are detailed histories of energy and society relations (Nye 1990, 1999, Rosa et al. 1988, Smil 2017, Sørensen 2012), but no explicit attempt to integrate between them. In chapter 4, I begin to do this by unpacking how particular energy forms do valued ‘work’ in repeating, rhythmic patterns, and then tracing in a broad historical sweep how new patterns of techno-energetic expenditures have co-evolved with shifts in social, economic and technological rhythms. Light and heat provide the particular focus, as two pervasive energetic forms that have particularly significant histories, as well as distinctive rhythmic and thermodynamic characteristics.

Solar flows of light and heat that we experience as the cosmological rhythms of day, year and season are still the foundation for planetary life in all its diversity, but over long histories of innovation and then industrialisation, these have become locally supplemented and modified by the application of lighting and heating technologies deployed with particular purpose and intent. As illumination extended into the dark (in both space and time), the time-keeping role of solar rhythms diminished, and the rhythms of everyday activity took on different shapes. As thermal technologies emerged in varied basic and more complex forms, new rhythms of cooking and cooling foodstuffs became possible, new rhythms of indoor climates became increasingly decoupled from the outdoors, and lives became disciplined and transformed by powerful new rhythms of industrial production and radically accelerated mobility. It is increasingly hard for those in societies full of techno-energetic flows to imagine the beats and pulses of everyday life and economy without pools, beams and pulses of artificial light and without thermal energies enabling things to be done with anticipated speeds, intensities and patterns of routine repetition. They have become inbuilt, creating dependencies and social fragilities if the techno-energies and the polyrhythmia they run through are disrupted.

Such histories of rhythm-energetic change have generated both positive and harmful outcomes for the rhythms of everyday well-being and social cohesion, as well as for the metabolic rhythms of human bodies. How these have played out has much to do with processes of economic growth, development and accumulation, as politically driven and moulded, meaning

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that there are both deep material investments in the energetically powered rhythms of contemporary society, and beats locked together in sequences and synchronizations that resist change away from ‘more of the same’ (Edensor 2010b, Reid-Musson 2018). Furthermore, there is not just one story of rhythm-energetic change, rather a host of social and spatial differentiations, meaning that beneficial outcomes have been unevenly distributed, and the ‘arrhythmic’ harms done to human bodies, to social relations and globally to the rhythms of the climate have been readily marginalised and ignored. Accordingly, in concluding chapter 4, I argue that the interrelation between rhythms and energies in society is always dynamic and differentiated, but there is no ‘silver bullet’ that might rapidly snap future rhythm-energetic relations into a better shape and form.

POLYRHYTHMIC ENERGY SYSTEMS

Energy systems, as developed, invested in, profited from and argued over, have been absolutely integral to techno-energies becoming woven into the rhythms of ‘modern’ societies. Energy systems are multicomponent and dynamic things (Haarstad and Wanvik 2017, Bennett 2005), encompassing the use of energy to power technologies (such as kettles for boiling water) that are part of all sorts of practices (such as drinking tea); the distribution of energy to reach those end uses across infrastructures (such as the electricity network); the generation of particular energy flows (such as from power turbines); the accessing of energy resources (such as gas, or wind energy resources); and the waste products and damaging consequences that spin out of system functioning (such as carbon emissions). In chapter 5, the tools of rhythmanalysis are applied to conceptualising energy systems, and the rhythm-energetic flows they contain and enable, as complex polyrhythmic assemblages that in their carbon heavy forms are deeply implicated in the production of the climate crisis. Even coal, it is argued, an apparently inert fossilized mineral, has rhythm and rhythmic effects.

In a limited body of existing work, the rhythms of at least particular elements of energy and infrastructural systems have been recognised to have important qualities or implications (e.g., Jalas et al. 2016, Janzen 2017, Blue 2018, Walker 2014), but there is more to be drawn out, examined and systematically interrelated. A few examples, featuring in a more detailed way in chapter 5, which focuses specifically on big grid electricity systems, can begin to make this apparent.

Large-scale time-use data—generated by people filling out detailed diaries on what they are doing over a day—have been analysed, in a growing number

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of studies, to reveal temporal patterns in the demand for energy (e.g., Jalas 2005, Torriti 2014, 2017). Such studies follow the logic that energy use is embedded in activity, or to be more conceptually precise, in social practice (Shove and Walker 2014). So understanding the dynamics of energy use (over days, weeks, seasons) involves engaging with the rhythmic repetition, sequencing and synchronization of energy-using practices in everyday life; rhythms of cooking, showering, watching TV, using a computer and so on. Scaled up to a collective level, such studies can then tell us something about the dynamics of energy demand in the aggregate, as well as about the making of the rhythmic peaks of demand (a form of temporal synchronisation between rhythms), which for electricity grids are particularly crucial in terms of the maximum peak loads they have to carry day to day.

Keeping electricity supply and demand in balance is vital to sustaining a functioning grid infrastructure, and it is achieved through the careful management of relations between fluxes in demand and fluxes in supply. In chapter 5, I characterise this as a grand, ongoing orchestration of energetic beats and pulses, centred on achieving a harmonic ‘isorhythmic’ (meaning equality of rhythms) relation between demand and supply curves. Anticipation, as a product of rhythmic repetition, I argue, is key to this achievement. On the one hand, individual end-users of electricity proceed on the basis that their forthcoming future worlds will be similar to equivalent pasts. They therefore get on with the shared rhythms of every-day life anticipating that electricity will be available and technologies will start up as normal. At the same time, those governing electricity systems anticipate that the rhythms of everyday life at a societal level will play out as they have done before, rather than varying randomly, and also that the rhythms of natural processes will repeat in terms of how they directly and indirectly shape energy demand curves. Grid operators coordinate supply to meet demand based on these mutually supporting anticipations of rhythmic order. Rhythms of energy very much *in* society, a co-production of social rhythms and technologically made flows of electricity, fragmented only when grid failures and blackouts dramatically—or in some contexts more routinely—disrupt their interrelation (Nye 2010).

In these examples, we can see glimpses of relevant social, technological, organisational, environmental and cosmological rhythms (sometimes expressed with more specific labels), with their own patterns, shapes, dynamics and interactions. However, the rhythms that make up energy systems are not equal in their effects or status, and how they are managed expresses relations of power and political commitment. In chapter 5, I argue that the long-established big (carbon) power model of electricity grid development and operation views rhythms selectively, through a dominant lens that foregrounds circulations of carbon commodities to the ends of the rhythms that

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generate growth. Through this lens, energy demand rhythms are seen as an emergent outcome of economic and social progress, self-forming and a dominant force, not rhythms to be intervened in, other than to build them up. Demand will be what it will be and the rhythms of power generation will be tightly orchestrated to ensure that supply will always be in place, from the rhythms of resource extraction, transport and processing onwards. As a result, in electricity-dependent, electron-permeated societies, the rhythms of resource depletion, carbon emissions and waste-making have been long ignored and distanced, with implications that only now are beginning to fully unravel.

RHYTHMS IN LOW CARBON TRANSITION

It is clear, therefore, that the rhythms of energy systems are not just what they are but are actively made and managed. The need not to just sustain functionality, but to transition rhythms into new shapes, patterns and inter-relations within electricity systems is the focus of chapter 6. Electricity systems as currently configured in much of the world have to change with considerable urgency and speed. A recent IPCC report (Intergovernmental Panel on Climate Change 2018) declares in stark terms, even in a carefully moderated summary for policy makers, how global warming will have a catalogue of damaging impacts when limited to a 1.5°C global mean surface temperature rise, and how much worse these will be if warming reaches 2°C. Exactly what this means and implies in terms of carbon targets, interventions and priorities is much debated but has intrinsically to involve reconfigurations of the polyrhythmia of incumbent electricity systems, with the carbon implication of electrons pulsing through infrastructural networks put resolutely in the foreground.

Some integral reconfigurations of rhythms are more obvious than others. The beats and pulses of renewable low carbon resources for generating electricity, such as wind and solar, are markedly different, and differently valued to those of coal and other fossil fuels. Instead of the closely coordinated rhythms of fuel extraction, transport and combustion, focused on the continuity of generation capacity at a few big power stations, the transition is to a future in which valued resource rhythms are widely distributed across a poly-energetic landscape. Rhythms of air movement, solar radiation and water movement coupled to fluctuating, discontinuous and intermittent cosmological-environmental rhythms that are variously predictable in their intensity and variation; and rhythms of electron flow that can be generated at macro and micro scales, powering both big grids and micro grids, or just a handful of locally connected technologies. The space and time of elec-

tricity generation is radically restructured, with low carbon rhythms valued over high carbon, and different possibilities opened up for who is in charge and who benefits.

Transitioning resource rhythms is only the start. Transferring the rhythms of hydrocarbon-powered mobility—fuelling, driving, refuelling—into the charging rhythms of electric vehicles where and when they are parked up introduces new peaks, troughs, intensities and unpredictabilities into the already complex task of orchestrating the rhythms of grid balance. Predictions of grid collapse and chaos are countered by visions of smart infrastructures and technologies tasked with making and sustaining a new isorhythmia of grid continuity, a version of what Coletta and Kitchin (2017) have termed *algorhythmic* governance, extending into the active management of the timing of demand, searching out and incentivising flexibilities through forms of ‘demand side response’ (Torriti 2016). When the rhythms of battery storage at scale enter the mix, real-time sensitivities in relations between the rhythms of supply and demand begin to diminish, but the specific durations and speeds of battery charging and discharging come to newly matter. In these and other ways, the many rhythms that give the electricity system its polyrhythmic form start to beat together differently when removing carbon becomes a primary aim.

These are transitions already started and underway, but unevenly so, as there are many resistances from the anticipated and locked-together rhythms and norms of electricity grid systems and their management. Resistances, for example, that push back against attempts to intervene in the rhythms of demand to reorder how and when energy is used in line with smart rationalities. Resistances that also seek to hold onto old ways of making electricity, keeping existing rhythms of power (energetic, but also economic and political) in place, rather than opening up to a field of more diverse and distributed possibilities.

DE-ENERGISING RHYTHMS

Even if the new beats and pulses of de-carbonised electricity systems do strengthen and overturn old polyrhythmic orders, this will still be insufficient as a response to climate emergency. I argue in chapter 7 that there is a need to go further into our entanglement in rhythms and energies in order to address not only the carbon that is released, but also the techno-energetic expenditures and dependencies that continue to evolve and reproduce in high-energy contexts in the Global North. And to do so in ways that can build social and environmental justice within transition processes (Bickerstaff et al. 2013,

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Routledge et al. 2018), including in relation to who globally has been most responsible for making carbon emissions, and who inter- and intra-nationally still lacks the most basic techno-energisation of the rhythms of everyday life. Decarbonisation, in other words, needs to be accompanied by de-energisation where techno-energetic dependencies are most intense. Approached from a rhythmanalytic perspective, this poses a series of questions. How can we, in high-energy societies, live through social rhythms that are less entangled with and dependent on techno-energies? How can connections and dependencies be rebuilt with rhythm-energies *outside* of energy systems? How can better synchronizations be formed with times, temporalities and rhythms that have the capacity to counter patterns of fracture, dissonance and injustice in human and ecological life?

Seeking after de-energisation at scale is a daunting ambition, implying stripping techno-energy use out of very routine and sedimented rhythms of getting things done, extending interventions into areas of ‘non-energy’ policy (Royston et al. 2018) and instilling reorientations to how different types of rhythms and energies should be valued and prioritised. However, it is an ambition and an objective that commentators and activists, largely on the margins, have been arguing for and attempting to enact in ‘disorderly’ ways (Edensor 2010b: 2), if not explicitly through a rhythmic framing. There are therefore a number of principles that can be distilled from existing writing and action that have rhythm-energetic recalibrations, replacements and remakings at their core.

In chapter 7, four such principles are identified and explored. *Deceleration* acting to slowing down the tempo of rhythmic repetitions and durations in mobility, but also in food systems, rhythms of consumption and product design; *reconnection* materialising forms of recoupling to bodily, ecological and environmental rhythms as a way of accessing energy services without techno-energies and managing energetic flows and interactions; *localisation* both in terms of spatially constraining the rhythms of movement and consumption, and attuning to the local poly-energetic landscape and its polyrhythmic patterning; and *sharing*, through forms of synchronization and sequencing that enable rhythms of reuse and recirculation, and economies of scale in energy terms from ‘things being done together’. In following each of these de-energisation principles there is potential for realising co-benefits for bodily and ecological health and for socially progressive outcomes, but also tensions that can arise from applying them in blunt ways, without giving sufficient attention to difference and context.

A broad field of practical possibilities, extending far beyond the traditional domains of ‘energy policy’, flow out of these rhythm-oriented principles. To centre on some more concrete examples, in chapter 7 I engage with three

sites of polyrhythmic formation—the body, the home and the city. These have some inherent ‘nesting’ in polyrhythmic terms, the rhythms of bodies being connected to those of homes and cities, and vice versa, and existing literature gives a starting point for conceptualising each of these sites in rhythmanalytic terms. Energetically they are also spaces in which multiple energies circulate, interact and have consequence, both ‘internally’ and in their interaction with other polyrhythms. For example, bodies are both polyrhythmic and poly-energetic, as experienced through everyday bodily sustenance, activity and performance, the conversion of calories into muscular movement and ongoing immersion in rhythm-energies of light and heat. Activating the rhythm-energies of bodies to replace movement with engines with movement through the muscular beats of walking and cycling is an obvious example of deceleration (to some degree), reconnection and localisation, with co-benefits for health, conviviality and ecology. To take another example, the clock times of cities are consequential for their rhythms of circulation and activity—starting and finishing work or education, opening and closing of retail spaces and so on—providing degrees of coordination and common scheduling across the city populace. How the clock time of a city is set in its cartographic location within a nationally determined time regime is also consequential for its energy consumption, in terms of how well its aligned to the rhythms of the planets that make the daily and seasonal cycling of solar time and flows of light and heat. Better synchronization of solar and clock time reduces dependencies on techno-energies, an example of how polyrhythmic interaction across vastly different scales can be at the heart of de-energisation objectives.

These are only two of the examples to be engaged with in chapter 7, most being to some degree familiar or part of existing advocacy and practice. The objective in this sense is not to be strikingly innovative, but rather to show how diverse rhythmic changes can be integral to de-energisation, and how a rhythmanalytic integration across the varied sites in which techno-energies are deployed can make new connections and provide a foundation on which future work may build.

RHYTHM AND GEOGRAPHY

This outline of the building blocks of my interpretation and deployment of rhythmanalysis has foregrounded the importance of temporal structures and dynamics to how energy is in society and to how responses to the current climate emergency are being crafted and resisted. However, rhythms—and their expenditures of energy—are not only temporal, they are also spatialized phenomenon; they have and make geographies (Crang 2001, Edensor 2010a,

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May and Thrift 2001). Much of the rhythmanalytic literature has engaged with how rhythms are situated and give character and content to the dynamics of particular places and spaces. For Edensor (2010b: 3), a rhythmanalytic perspective ‘avoids the conception of place as static’, opening up instead how places are ‘seething with emergent properties, but usually stabilised by regular patterns of flow that possess particular rhythmic qualities’. These counterpoints of stability and change will feature repeatedly through the book but resonate particularly in thinking about the rhythms of homes and cities in chapter 7. Similarly, it is clear from geographical, ethnographic and socio-logical work on energy and energy systems (e.g., Bradshaw 2010, Bridge et al. 2013, Calvert 2016, Castán Broto and Baker 2018, Huber 2015) that how energy flows through society—its amounts, intensities, forms and temporal patterning—is also a situated matter, subject to the particularities of history, culture, politics, infrastructure and environment, and thoroughly immersed in their making. There are universal laws of thermodynamics, and therefore of energetic exchanges and transformations, but how exactly energy is *in* society in all its diversity is far from the reach of any universal principle.

This means that geography matters to bringing energy and rhythm together, but in writing this book I have tried to be not too constrained to a particular geographical scope. Most of the research I have been engaged with has been empirically centred on the United Kingdom, so that geographical (rhythmic and energetic) context will feature more than others. But, I will be at pains to remember its particularity, and will attempt to point out significant dimensions of spatial, economic and cultural difference, without claiming to provide a properly global account or an analysis that is fully sensitive to place and situation. The rhythm-energetic vignettes that feature through the book are mine and can only reflect what and where I have experienced, but even so they are not only situated in my home setting.

READING THIS BOOK

I have written this book with various readers in mind; it has a multidisciplinary scope drawing from physics and ecology through to human geography, sociology and anthropology, and therefore I hope a multidisciplinary readership. While it is structured like most academic books with a linear logic—a structure that builds from chapter to chapter and introduces terms and ideas before their application—linear reading is relatively rare. With both different readers and patterns of reading in mind, I can suggest a few alternative paths. Readers interested primarily in rhythm might find particular value in chapter 2, which runs through core concepts in rhythmanalysis and adds a

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little in terms of categories of rhythm and rhythmic interrelation, proceeding then into chapter 3, which addresses rhythms in the conjunction of space, time *and* energy, before keeping track of the strategies of rhythmanalytical investigation used in chapters 4 through 7. Readers interested primarily in energy, might start with chapter 4 with its historical narrative, flipping back into chapter 3 to follow some of the lines of more conceptual argument, before then engaging with the analysis of rhythms in electricity systems, low carbon transition and the dynamics of de-energisation in chapters 5 through 7, depending on what is of most interest. If convinced of the value of thinking with rhythm, working through chapter 2 at some point would also be strongly recommended. Readers concerned primarily with climate change might have particular interest in the end of chapter 3 where I most directly engage with the rhythms of climate itself, before then tracking the implications of the historical narrative of rhythm-energetic change in chapter 4 for carbon emissions, and following the argument that transitioning rhythms is an integral part of carbon mitigation in chapter 6 and the need to do more than only de-carbonisation in chapter 7. Other reading rhythms can of course be followed.