2
Theorising Energy Transitions

Transitions can be thought of as radical shifts in the provision of services such as energy, transport, food and sanitation. They often refer to a change in the state of a system, rather than merely a change in technology or fuel source, for example (Grubler et al. 2016). Indeed, originally the term transition was used by scientists to describe ‘phase transitions’ of substances going from solid to liquid to gas, that is, a fundamental change in state (Verbong and Loorbach 2012: 6). Applied to the questions of societal responses to sustainability challenges, transitions combine social, economic and technical elements of finance and innovation, technologies, infrastructures, regulation, cultural change and social pressure and seek to disrupt and displace the previous way of doing things. Diverse literatures place different emphasis on which are the primary drivers of transitions and how best to understand them.

Significant emphasis has been placed on modelling work through quantitative energy-environment-economy models, in particular integrated assessment models (IAMs). IAMs are designed to help us understand how human development and societal choices affect each other and the natural world. They are ‘integrated’ because they combine different strands of knowledge to model human society alongside different parts of the Earth’s system (Parson and Fisher-Vanden 1997). IAMs seek to combine knowledge from multiple disciplines in formal integrated representations to inform policymaking, prioritise key uncertainties and advance knowledge of broad system linkages and feedbacks, particularly between socio-economic and biophysical processes. They combine simplified representations of the socio-economic determinants of energy pathways, the atmosphere and impacts on human activities and ecosystems, and potential policies and responses (Parson 1995).

They tend to vary, however, in their conclusions on the scale and direction of the likely macroeconomic impacts of a low carbon transition. The characteristic discrepancies in models’ outcomes have been traced to their origins in different
macroeconomic theories, most importantly their treatment of technological innovation and finance, by relevant branches of macro-innovation theory: ‘equilibrium’ and ‘non-equilibrium’. While both approaches are rigorous and self-consistent, they frequently yield opposite conclusions about the economic impacts of low carbon policies such as carbon taxes, for example. Model outcomes are mainly determined by their representations of monetary and finance dimensions, and their interactions with investment, innovation and technological change (Mercure et al. 2019). Despite critiques of their limitations as predictive tools or problematic framing assumptions, they continue to underpin policymaking in key areas of energy and climate politics, where the Intergovernmental Panel on Climate Change (IPCC), for example, relies heavily on them in constructing different scenarios for achieving climate goals.

2.1 Sociotechnical Transitions

There is also now a substantive and wide-ranging literature on what are often called sociotechnical transitions which often build on, but go beyond, these models. This is a broad umbrella label for a series of literature derived from innovation studies that includes work on strategic niche management and transition management as well as the Multi-Level Perspective (MLP) (see Figure 2.1). Markard et al. (2012) identify four frameworks for transition studies: transition management, strategic niche management, technological innovation systems and the MLP. Early emphasis was on technological innovation systems, while the Dutch school emerged from science and technology studies (STS) and evolutionary economics and sought to combine an understanding of specific technologies with a macro-view of historical change. These seek, in different ways, to identify and explain the necessary social and technical components of a sociotechnical transition (Geels 2005; Geels and Schot 2007; Loorbach 2007). The focus of explanation has widened over time to include STS, economics and, more recently, politics and international relations (IR) (Meadowcroft 2009; Kern 2011; Newell 2018; Kern and Markard 2016; Sovacool 2014; Arent et al. 2017).

At the centre of many current applications of sociotechnical transitions is the popular MLP. Conceptualised as ‘major technological transformations in the way societal functions such as transportation, communication, housing, feeding, are fulfilled’ (Geels 2002: 1257, emphasis added), a great deal of insight into the nature of sociotechnical transitions has been generated through this ‘multi-level perspective’ on transitions. The MLP explores the interaction of elements of a sociotechnical system across several levels, from a niche technology and its supporters seeking to break into a market controlled by incumbent interests,
thought to be part of a regime (often assumed to be operating at the national level),
up to a series of landscape pressures that are often assumed to emanate from the
global level (see Figure 2.1).

‘Niches’ provide a space within which social and technological learning
processes and network building can be nurtured to develop alternative forms of
sociotechnical configuration. Niche spaces often depend on support from the
landscape or the regime to cultivate the economies of scale and scope to become
competitive. ‘Regimes’, in contrast, are made up of the complex of practices,
regulatory requirements, institutions and infrastructures required to achieve par-
ticular societal functions such as housing, mobility or power. This provides
a useful point of departure for thinking about the role of incumbent actors
involved in fossil-fuel energy systems whose structural dominance in energy
investment and policy shapes the spaces available for developing alternatives.
The ‘landscape’ of a sociotechnical system, meanwhile, is seen as comprising the
structuring forces of ideologies, institutions, discourses and political and economic trends that constitute enduring forms of sociotechnical organisation. These landscape pressures include climate change and shifts in international energy markets which exert disruptive pressure upon the regime as the prevailing way of organising an energy system and its services, the effect of which can be to enable a transition away from this dominant mode of organisation while creating space for niche innovations to be supported.

The approach helps to explain how sociotechnical systems are both sustained and reconfigured. The need to understand the ways in which pressures from above and below can ‘lead to cracks, tensions and windows of opportunity’ (Geels 2010: 495) opens up space for insights from political economy about who the agents are in this process and how the forms of power that they exercise are able to bring about or resist transitions in energy systems. Successful systems are regarded as tending towards stability, held in place through regimes with ‘relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks that determine the “normal” development and use of technologies’ (Smith et al. 2005: 1493). The operations of these regimes in turn create both ‘path dependency’ and ‘lock-in’ (Unruh 2000) to certain forms of dominant energy sociotechnical configuration, while others remain ‘locked out’ and marginal. It is expected that structural changes in the sociotechnical system occur where there is positive configuration and there are ‘alignments’ among the three levels resulting in ‘transitions’. This means that the ways in which regimes, niches and landscapes interact will have an effect on the form of transition that unfolds; a plurality of possible transition pathways can result. Typically, these involve shifts that permit the increasing influence and development of niches as sociotechnical configurations, and the unsettling, decline and discontinuity of regime configurations. The successful penetration of a niche development pathway would be indicated not only by increasing shares of renewables in the energy mix, for example, but also by greater power for renewable energy actors in the design and development of energy institutions.

There are a number of limitations, however, with this body of scholarship and its ability to effectively account for the global political economy of energy transition and the key dimensions explored in this book. Firstly, there is still a Eurocentric orientation to much of the theorising about transitions to date, which limits its ability to account for global experiences or the relationships between transitions. The Netherlands is the historical epicentre of transition studies in universities such as Delft, Eindhoven and Utrecht. Because work on sociotechnical transitions has typically been focused on Europe, it inevitably makes assumptions about the nature of state capacity, markets, institutions and infrastructural systems that do not hold in
many parts of the world, for example, where state capacity is often weak and institutions are subject to elite capture and lack of resources, or where markets and infrastructural systems are under-developed (Power et al. 2016).

Likewise, European experience, in which access to energy is more or less universal and where structures of energy provision such as electricity and transport are heavily regulated and energy governance has not had to deal with crises such as outages and an outdated grid, is held up as the norm. In contrast, in many parts of the world, energy access is far from universal and there are multiple forms of energy provision operating concurrently, from the large-scale hydroelectricity for heavy industrial use to burning firewood and charcoal for domestic use. Moreover, in Europe, many countries have liberalised their electricity sector whereas, elsewhere, state control over the energy sector remains resolutely in place. In South Africa, for example, there is a monopoly utility in the form of Eskom (Baker et al. 2014). Some scholars have started to study transitions beyond European settings including in countries in Asia (Smits 2009; Berkhout et al. 2009; Mori 2018), Latin America (Howe 2015; Rubio and Folchi 2012) and sub-Saharan Africa (Baker et al. 2014; Power et al. 2016; Newell and Phillips 2016), combined with more interconnected, comparative (Hochstetler and Kostka 2015; Hochstetler 2021), multi-scale and regional or global perspectives on sociotechnical transitions (Truffer 2012) that are of greater relevance for understanding developments in other settings.

Relatedly, Eurocentrism in transition studies can lead to a partial historical understanding of the material and social basis of transitions in terms of the financing, exchange and flows of raw materials that enabled the creation of new infrastructures for energy, transport and housing, for example. Transitions in Europe (and elsewhere) have been prefigured or are often contingent upon both historical (often colonial) and contemporary patterns of extraction and disruption elsewhere (Lennon 2017). The issue is not just extraction and exchange, however, but the reinvestment of profits in energy regimes. The circuits of finance capital by which profits from slavery, plantations and colonial dispossession were first acquired and then recirculated are ripe for analysis regarding the ways in which they were invested in the industrial revolution and a series of major energy infrastructures such as railways (Williams, E. 1994 [1944]; Inikori 1987). It is no coincidence that the industrial revolution was funded by a few people who held the power to issue essentially infinite credit (Heaton 1937) including, of course, to finance the experiments of James Watt, inventor of the steam engine. There is further work to do in foregrounding this pre-history in studies of energy transitions when they unfold in uneven racialised economies (Tilley and Shilliam 2018).

Building on this critique of prevailing Eurocentrism, others have sought to emphasise the importance of different geographies of transition (Bridge et al.
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Geographical work has focused on energy poverty and justice (Broto et al. 2017), energy transitions and renewable energy (Power et al. 2016), land grabbing and social oppression linked to large-scale energy investments (Finley-Brook and Thomas 2011), extractive industries (Kirshner and Power 2015) and cultural aspects of new lighting technologies (Kumar 2015). Geographers have provided evidence of how economic, political, social, spatial and technical dynamics shape, enable and constrain energy systems, at various scales. For example, they have shown how large-scale electrification initiatives across polities are refashioning the geographies of statehood in a variety of settings and scales (Power and Kirshner 2018; Gore 2017): in households, by means of new ‘smart’ subjectivities; through solar and energy-efficient lighting; along development corridors, as a result of the electrification of railway lines and attendant claims to technological prowess by developmental states; and in long-neglected peripheries, through decentralised control over electrification in the ‘renewable peripheries’ (Calvert 2015).

Secondly, a certain methodological nationalism prevails in transition studies as opposed to a focus on networks, assemblies and landscapes (Newell and Bulkeley 2016). This means, that, as well as the Eurocentrism and failure to capture the diverse and uneven geographies and pre-histories of transition just noted, dominant approaches are often unable to account for the interrelationships between transitions: how national transitions and choices of pathways have global repercussions (Selby 2019). Or how these are often dependent on resourcing or outsourcing solutions to other parts of the world, whether it is the impact of the use of biofuels in transport on land use and access in southern Africa or the rise of electric vehicles (EVs) and their impacts on conflicts over rare earth minerals in parts of central Africa (Sovacool 2019) or the use of carbon offsets for projects in the global South (Newell and Bumpus 2012; Böhm and Dhabi 2009). More generally, transitions literature also has relatively little to say about questions of (geo)politics and diplomacy, or about the political factors that impact on interstate economic relations and domestic and international energy policy choices, despite the emergence of a growing literature on the international political economy of energy (Van de Graaf et al. 2016; Goldthau et al. 2018; Newell 2018; Van de Graaf and Sovacool 2020).

Thirdly, the foregrounding of technology within transitions means that approaches typically place significant emphasis on the ability of ‘bottom-up’ niche-led innovations to bring about change, but often fail to adequately consider powerful landscape or regime stakeholders such as multinational firms, whose behaviour cannot be easily shaped by the state in many contexts (Newell and Bulkeley 2016). In this sense, there is a need to bring political economy into sociotechnical literature to allow us to understand how, where and why transnational actors shape the
regimes, landscapes and niches of energy systems and with what implications. Part of this involves building on emerging strands of work concerned with undoing incumbency and the destabilisation and discontinuity of regimes (Johnstone and Kivimaa 2018; Rogge and Johnstone 2017; Stirling 2018; Kungl 2015; Leipprand and Flachsland 2018). This is critical because unless incumbent regimes are actively and more rapidly disassembled, no amount of support to niche actors will enable energy transitions in line with what is required to meet the goals of the Paris Agreement.

Fourthly, despite a rich body of historical cases of transition (Arranz 2017; Allen 2012; Fouquet 2016a, 2016b; Fouquet and Pearson 2012; Arapostathis and Pearson 2019; Podobnik 1999), the literature often fails to engage with the deeper political enabling environments that have nurtured disruptive change historically and whether relevant insights can be gleaned for today’s world. Work on ‘deep transitions’ has sought to address this gap to some extent by looking at how ‘socio-technical systems are an expression of a limited number of meta-rules that, for the past 250 years, have driven innovation and hence system evolution in a particular direction’ (Kanger and Schot 2018: 1045; Johnstone and McLeish 2020). A deep transition is formally defined as a series of connected and sustained fundamental transformations of a wide range of sociotechnical systems in a similar direction. Examples include moves towards increased labour productivity, mechanisation, reliance on fossil fuels, resource-intensity, energy-intensity and reliance on global value chains. The political projects and constellations of power underpinning and driving these shifts warrant further attention, however.

If more political takes on transition histories have been lacking, recent contributions have sought to address the neglect of politics in much mainstream transition literature (Meadowcroft 2009; Geels 2014; Kern 2011; Kuzemko et al. 2016; Arent et al. 2017), seeking to extend the predominantly European and technocratic focus of scholarship on transitions to other areas of the world (Power et al. 2016; Baker et al. 2014; Newell and Phillips 2016) and to pay greater attention to the role of institutions (Kern 2011; Geels 2014). Cherp et al. (2018), meanwhile also develop a ‘meta-theoretical’ framework that integrates techno-economic, sociotechnical and political perspectives on national energy transitions. They depict energy transitions as a function of the co-evolution of three types of system: energy flows associated with energy production and consumption coordinated through markets, energy technologies for extracting, utilising and transforming energy, and energy-related policies regulating the socio-political role of energy systems. This is combined with three perspectives: techno-economic with its roots in energy systems analysis and economics; sociotechnical grounded in sociology of technology, STS and evolutionary economics and focused on knowledge, practices and
networks associated with energy technologies; and political based in political science addressing systems of political action. They follow Grubler et al.’s (2016) definition of energy transition as a change in the state of an energy system, as opposed to a change in an individual energy technology or fuel source. From the perspective of political economy, the techno-economic and sociotechnical practices, networks and forms of political action are all deeply political, such that the contributions of global political economy (GPE) analysis are not just confined to the latter perspective, as will become clear throughout the book.

The benefit of combining these approaches is to go beyond the insights of techno-economic modelling, through IAMs, for example, to engage with the social and political context in which decision-makers choose one pathway over another. Sociotechnical perspectives help to capture inertia and path dependence, often referred to as ‘lock-in’ (Unruh 2000), and the role of rules and routines by looking at the configuration of technologies, services, infrastructures and regulations, for example (Schot et al. 2016). The emphasis is very much on the conditions of emergence of new niches and modes of service provision, and less so on how to manage or accelerate the decline of incumbents (Turnheim and Geels 2012). Thinking politically about the economic components of transition can be addressed, in part, by applying ideas about varieties of capitalism to transition studies (Lachapelle and Paterson 2013; Mikler and Harrison 2012; Benney 2019), which helps to get at the diversity of political economies and state-market configurations that shape transition pathways.

The emphasis on politics brings in overdue attention to the state (Meadowcroft 2005; Johnstone and Newell 2018), including both state-centric and state-structural approaches, as well as questions of power (Meadowcroft 2009; Scoones et al. 2015). Work on historical institutionalism adds to this an understanding of how the institutional organisation of the polity and the economy privileges some actors and interests to the exclusion of others (Lockwood et al. 2016), while work on policy paradigms (Andrews-Speed 2016) helps to account for shifting framings and ideologies in politics. Other studies have looked at the role of party politics. For example, a study by Hess and Renner (2019) cautions against assuming an automatic linkage between far-right parties and opposition to energy transition policies and against assuming that far-right parties will oppose all types of energy-transition policy.

But we continue to lack analysis of the deeper politics of transition in terms of the distributions of power and the re-casting of state–market relations required to bring about transformations in energy production and consumption, informed by historical analysis of the conditions in which these have been achieved before and
foregrounding questions of (political) ecology relative to the (often assumed) sustainability of different transition pathways. Placing global articulations of power and political economy, history and ecology at the forefront of analysis, as is proposed here, both challenges and goes beyond the useful but narrower focus upon sociotechnical transitions and their governance in the existing literature. It does so by foregrounding the relations of global power that shape particular institutional configurations and sociotechnical possibilities.

2.2 From Transition to Transformation

The word transition implies a shift in state. We transition from life to death and people undergo life transitions such as parenthood and retirement. Economies are said to be ‘in transition’ – a label applied to formerly Socialist Central and East European economies as they ‘transitioned’ from socialism to capitalism. There is often an implied direction of change – forward, a profound change from one state of being to another, something intentional and assuming agency – often that of the state or some higher power deriving from a God or deity. This is the case even though many profound transitions in history have been propelled by market and private actors – or social movements. Think about revolutions in IT or mobile phone use, or deep cultural shifts around attitudes towards gender equality, slavery and colonialism in which the state was often a passive, reactive actor or active in obstructing change.

Debates about transition are full of multiple, though often unstated, theories of change. There is a disciplinary dimension to this where economists tend to look at shifts in the prices of commodities and system change as a function of shifts in finance capital (Perez 2002), or the ability to provide (energy) services more cheaply (Fouquet 2016a), while sociologists and psychologists look at cultural shifts and the evolution of social values, norms and practices (Whitmarsh 2009; Shove 2003). The sorts of shifts that IR scholars study include grander geopolitical shifts in world order from the Pax Britannica to the Pax Americana, for example (Cox 1987; Desai 2013). To complicate things, historical processes described by some as transitions are more disruptive and re-constitutive of political, economic and social orders than a reconfiguration of sociotechnical assemblages and probably, therefore, more deserving of the label transformation. For example, in political Marxism, the ‘transition debate’ concerns the systemic change in a mode of production: the transition from feudalism to capitalism (Wood 2002). Likewise, ‘economies in transition’ from socialism to capitalism might, in reality, be said to be undergoing profound transformations, in many cases resulting from revolutions. Activists are sometimes more explicit in articulating the transformative nature of
their project as one of ‘sparking a worldwide energy revolution’, for example (Abramsky 2010).

Given the need to challenge the narrow framing of transitions in neo-liberal terms as a realignment of technology, finance, infrastructures and institutions, where business as usual power configurations persist, others prefer the language of transformations to distinguish more discrete realignments of sociotechnical functions and service provision from more disruptive and deeper change that seeks to chart a different direction, pursue different goals and consciously unsettle existing power relations (Newell 2018; Stirling 2014; Scoones et al. 2018). In the case of the former emphasis on transitions, Newell and Martin (2020) refer to a ‘plug-and-play’ approach to energy transitions where new technologies are adopted and financed, but power and decision-making authority continue to reside with incumbents. These tend to generate and reproduce negative outcomes, socially and environmentally, because the same providers and business models grounded in extractivism are in play. Rather than replacing fossil fuels, renewable energy sources may be ‘additive’: merely expanding the overall amount of energy that is produced (York and Bell 2019).

Often transitions and transformations are intimately connected. As Gore (2017:9) suggests, ‘it is important to distinguish between technical energy transitions and the multiple, contested political and social transformations that underpin those transitions’. But in many ways the language of transformation more accurately describes the scale of the challenge and the need to address power relations which narrow transitions, understood as reconfigurations of sociotechnical practices around key services (mobility, cooking, heating, etc), might not require. Herein lies the tension between the increasingly recognised need for transformation and the ability of incumbent actors to narrow the debate to questions of incremental transition through ‘trasformismo’ (Newell 2018). Applied to transitions, this refers to the ability to accommodate pressures for more radical and disruptive change and to employ combinations of material, institutional and discursive power to ensure that shifts which do occur in sociotechnical configurations do not disrupt prevailing social relations and distributions of political power. The Gramscian concept of ‘trasformismo’ describes a process of co-optation that ‘serves as a strategy for assimilating and domesticating potentially dangerous ideas by adjusting them to the policies of the dominant coalition and can thereby obstruct the formation of organised opposition to established social and political power’ (Cox 1983: 166–7). In the current world order, a combination of ideational, institutional and material sources of power serve to maintain the status quo and accommodate pressures for more far-reaching change, in ways usefully highlighted in work which draws on Antonio Gramsci’s insights on hegemony (Cox 1987; Levy and Newell 2002). As laid out in the argument in Chapter 1, such strategies are central to
the ability of capitalists to be able to claim that energy challenges and climate crises can be addressed through market society and do not pose a threat to its basic organisation and imperatives.

Typologies can be developed to explain and characterise the different forms transformations take. They can be more state-led; market-led, technology-led or citizen-led, whereby these overlap, compete and reinforce one another in different configurations in different parts of the world (Scoones et al. 2015). This has led some to characterise the competing politics of transitions in terms of pathways – an approach developed by the STEPS centre at Sussex. Here it is suggested: ‘In a complex world it is practically and analytically useful to think in terms of systems, describing how changing, interacting social, technological and environmental elements are configured around a given issue.’ Pathways then are ‘the particular directions in which such systems change over time’ (Leach 2010). Central to the pathways approach is a recognition of more than one way of ‘framing’ – understanding and representing – a system. Framing involves choices about ‘which elements of the system to highlight, where its boundaries are and at what scale to view it, as well as subjective and value judgements about it. Particular system-framings often become part of narratives about a problem or issue: simple stories that suggest how systems should develop to bring about particular outcomes or goals.’ In this regard, attention to multiple framings and narratives opens up opportunities to advance sustainability debates and connect them more firmly with social justice by revealing the interests, biases and power relations at play. ‘Processes of governance mean some narratives and pathways dominate, while others remain marginalised. The claim is then that “lock-in” to a particular powerful narrative and associated pathway can exclude others’ (Leach 2010). The normative project of the pathways approach is to ‘open up’ and make space for more plural and dynamic sustainabilities, challenging dominant narratives and pathways, and highlighting alternatives, including those reflecting the perspectives and priorities of poor and marginalised people in particular settings. But negotiating pathways to sustainability is not just about opening up a plurality of options; it is also about the political process of building pathways which are currently hidden, obscured or suppressed (Leach 2010). How, why and by whom they are obscured or suppressed brings us back to the question of the exercise of incumbent power.

2.3 Political Economies of Transition

We need to understand (i) where power comes from (literally); (ii) how it is held, sustained and reproduced and (iii) how, where and when it might change. Historical materialism affords insights into the relationships among power, production and
world order (Cox 1987) and hence affords a more global and historical conceptualisation of incumbency. Historically specific configurations of geopolitics and institutional constructions of global governance reflect a particular base of production and an associated set of energy resources. These different historical conjunctures have been described in terms of ‘petro-market civilisation’ (Di Muzio 2012), ‘carbon capitalism’ (Di Muzio 2015), ‘fossil capital’ (Malm 2016) and, more specifically and contemporarily at this conjuncture, ‘climate capitalism’ in a finance-led regime of accumulation (Newell and Paterson 2010). But, as we will see in this chapter, such accounts also afford the possibility of understanding the potential for change at key historical junctures based on a reading of where power lies and which social forces are more dominant as well as weaker.

Political economy analysis also helps to explain the operation of hegemony and interacting sites of power derived from and manifest in material, institutional and discursive sites of power (Levy and Newell 2002). Hegemony, as Gramsci frequently underlined, is never complete. Hence a political economy account also requires a focus on the fractures, vulnerabilities, openings for change, resistance and transforming or transcending the current energy order. A political economy approach places questions of states and markets and their interrelationship, and of production, consumption and exchange, centrally. But by placing questions of power centre stage, reflected in patterns of participation and representation, for example, it also invites questions about procedure and distribution and the relationship between the two. This provides us with a stronger basis for understanding why energy policy serves some social groups over others and is more responsive to some interests than others. We explore this further in Chapter 5 on governing energy transitions where we look at questions of institutional access, donations to political parties, revolving doors between business and the state, access to the media and sponsorship of advertising and working through cultural spheres of education and the arts to validate the role of fossil fuels in society, as part of a broader notion of civil society that a Gramscian analysis enables.

This last dimension of culture and ideology and ‘economic imaginaries’ (Jessop 2010) sets a more Gramscian political economy approach apart from other strands of historical materialism and, as we will see in Chapter 6 on mobilising and culturing transitions, is viewed as an important site of struggle in itself. There is a bridge here to cultural political economy (Bulkeley et al. 2016) and the ways in which shifting economic practices and governmentalities can usefully be viewed through cultural lenses. How, for example, ‘contemporary forms of carbon government work through calculative practices that simultaneously totalise (aggregating social practices, overall greenhouse gas emissions) and individualise (producing reflexive subjects actively managing their greenhouse gas practices)’ (Paterson and
Powerful narratives meanwhile about ‘keeping the lights on’ and the relationships among energy, employment and growth serve to shut down alternative pathways while legitimating incumbent ones.

2.4 Globalising the Political Economies of Energy Transition

What makes the political economy account developed in this book global is its attention to the global organisation of transitions across space and time. We will discuss the historical dimensions of this next and have already noted the importance of acknowledging the pre-histories of energy transitions. But in the contemporary world, there is a geopolitics and international relations of energy transitions that needs to be attended to. Decisions, choices and pathways cast in one part of the world have global consequences, as discussions of global energy justice make clear (Sovacool and Dworkin 2014). The social and ecological shadows cast, the uneven distribution and displacement of risk across societies, regions and between generations bear testimony to this relational dynamic of interdependence (Choucri 1976). The global production, exchange and distribution of technology, finance, materials and flows and the capture of value reflect and advance existing uneven capitalist relations that are both historically constituted and socially differentiated.

Hence, while there is increasing attention in scholarship on sustainability transitions research to issues of power, politics and governance (Köhler et al. 2019), it currently neglects the potential contribution of critical GPE to understanding the broader political and economic landscapes which shape transition pathways, the global interrelationships between national-level transitions and to an appreciation of the shifting role of the state in a context of globalisation (Newell 2020c). In this book, I make the case for drawing on more critical strands of GPE that have thus far been neglected, to help situate sustainability transitions within particular historical conjunctures: the deeper political projects of reordering the economy that can contribute to work on ‘deep transitions’ (Kanger and Schot 2018). This can be done through reference to shifts in the stages of capitalism where, for example, an understanding of industrial mass production and consumption can be fruitfully understood in relation to the hegemonic power of the United States (Rupert 1995) linking the geopolitics of security to economic transformations. As Hoffmann (2018) observes, it was not that the invention of the internal combustion engine by a German engineer revolutionised the world economy. ‘It was only [through] its mass production within the US capitalist social formation that this innovation became the core of a new industrial age and, eventually […] Fordism informed the constitution of a new global order’ (Hoffmann 2018: 42). An account grounded in critical GPE affords an understanding of the historical and contemporary
interrelationships between transitions in different parts of the world which reflect the uneven distribution of power in the international system as well as vitally locate the state in a global context in relation to its insertion within the global political economy. The critical GPE scholarship which is most useful in this endeavour deals with the nature of neo-liberalism and the spatial and temporal fixes that are often employed by powerful states to avoid domestic restructuring (Harvey 2003), a dynamic we can clearly see across a variety of sociotechnical transitions, and scholarship on the changing nature of the state in this context (Cox 1993; Jessop 2002).

Firstly, work within critical GPE can help to situate transitions within particular historical conjunctures. This is not just about providing rich histories of transition which existing scholarship has amply attended to, as noted already. Nor is it merely about ‘investigating how multiple regime shifts can shape landscape developments and thus societies as a whole’ (Köhler et al. 2019: 5). In MLP terms, it is about taking much more seriously ideological and political landscape pressures which bear down on regimes and which may help to explain continuity and commonality among approaches to transitions across sectors even amid the diversity of contexts. Though there is clearly variety across sociotechnical transitions even within the same country, visions and ideologies regarding the role of the state and the private sector permeate across individual transitions through programmes of privatisation, for example, and global reform programmes propagated by multilateral institutions like the World Bank. Work on neo-liberalism and the way it constrains and enables particular transition pathways has an important contribution to make here (Newell and Phillips 2016), or on the growing financialisation of the global economy which brings both challenges and opportunities for transitions (Newell 2018), but where an historical understanding of the power of finance capital is critical (Perez 2002). This provides a more specific account than more general theorisations of capitalism and sustainability transitions (Feola 2019). It affords comparisons across historical periods and regions to look at how dominant ideologies (such as Keynesianism and Fordism) shape what is possible in terms of shifts in production, changes to labour and what are seen as legitimate forms of state intervention. Parallels are often drawn between the industrial revolution which started in England in the late eighteenth century and what is needed today to accelerate transitions to a low carbon economy, or between President Roosevelt’s New Deal and a contemporary version of it, but often without sufficient attention to the political context in which they emerged and whether they can be replicated.

A robust GPE analysis could, on the one hand, hone in on particular configurations of power at national level, illustrated, for example, through the application of the idea of a minerals-energy-complex (MEC) to the case of South Africa’s energy
transition (Baker et al. 2014), but, on the other, then ‘scale up’ to the geopolitics of
transition to understand the significance of China’s rise for the financing and
governance of transitions, for example. As Köhler et al. (2019: 7) note, there are
‘interesting but unexplored questions about how global power shifts (such as from
the West to the East) will influence the international politics of transition pro-
cesses’. The analysis needs to move beyond an assessment of how the rise of
BRICS countries impacts on transitions elsewhere (Schmitz 2017; Power et al.
2016) to explore how the very goals, modalities and possibilities of transition might
be reimagined in different geopolitical circumstances, making a contribution to
forward-looking analysis of emergent transitions.

Secondly, insights from GPE can provide an account of the interrelationships
between transitions in different parts of the world as they are constituted historic-
ally and made in the present. Energy is imported and exported as part of the routine
functioning of the economy. Choices made in one country have direct implications
for resource, availability and access elsewhere. Whether it is increased demand for
biofuels putting pressure on land that could be used for growing food, or the rush for
lithium and other minerals to support expanded demand for renewable energy and
electric batteries (Romero 2019), states and corporations displace food, water and
energy challenges onto other countries, and often poorer populations in particular
(Sovacool 2019). How these trade-offs are resolved, and on whose terms, reflects
the exercise of power between states and classes. Critical scholarship on the
‘spatial’ and ‘temporal’ fixes that are employed to avoid crises in the core of the
global economy by sourcing solutions elsewhere or into the future (Harvey 2003)
(through carbon trading, biodiversity offsets, water grabs and the like) is helpful in
understanding these dynamics. GPE scholarship on global production networks and
value chains (about which more in Chapter 3), meanwhile, can helpfully provide an
analysis of how capital employs spatial and temporal fixes to manage crises. This
type of approach will help transition scholars to anticipate and engage with the
justice dimensions of transitions that are coming to the fore in debates about just
transitions (Swilling and Annecke 2012; Morena et al. 2019) and ideas of global
energy justice (Sovacool and Dworkin 2014).

Thirdly, GPE scholarship can help to locate the state in a global context in
relation to its insertion within the global economy. These issues are core concerns
in GPE amid debates about the ‘retreat of the state’ (Strange 1996) and the degrees
of policy space available to developing countries to pursue autonomous develop-
ment pathways (Wade 2003). These can easily and fruitfully be extended to studies
of transitions to better understand the power relationships which impact on emer-
gent transitions in large parts of the majority world in particular, where donors and
transnational business actors often play a decisive role in shaping transition

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trajectories (Power et al. 2016; Newell 2018). To do this effectively, such accounts need to be cognisant of all dimensions of state power (Johnstone and Newell 2018) and not just those to do with technology and innovation or sectoral responsibilities, including military dimensions which many scholars of global politics take as their starting point.

2.5 The International Relations of Energy

Notwithstanding recent literatures in IR on global energy governance (Florini and Sovacool 2009, 2011; Van de Graaf 2013; Goldthau and Witte 2010) and on global climate governance (cf. Bulkeley and Newell 2015; Hoffmann 2011), the global politics and political economy of transition from one energy order to another, as is required to address climate change, have been neglected. Besides a very recent spike in interest (Di Muzio and Ovadia 2016; Van de Graaf et al. 2016; Kuzemko et al. 2018, 2019; Van de Graaf and Sovacool 2020), Susan Strange’s invitation in her seminal book on States and Markets (1988) to take energy seriously in IPE has not been taken up for the most part by the broader discipline, where a mutual neglect by IPE scholars of questions of energy (beyond oil) and energy transitions in particular, as well as by energy policy scholars of IPE, persists, thereby frustrating a productive cross-pollination of insights. Given the centrality of energy to state power, geopolitics, international economic relations and the global politics of sustainability, this is particularly surprising and problematic.

Energy is the lifeblood of modern society and is central to the contemporary global political economy through its relationship to growth, statehood, militarism and geopolitics (Huber 2013; Bromley 1991; Yergin 1991; Malm 2016; Mitchell 2011; Painter 1986; Labban 2008; Wrigley 2010). In spite of this fact, energy has often been neglected within the discipline of IR. Traditionally its role in international affairs has been reified and naturalised – reduced to the status of material resource external to the state and state formation. Work on what may be broadly described as the political economy of energy has looked at the international politics of energy interdependence (Choucri 1976), and the broader international relations of energy, particularly with regard to energy security (Moran and Russell 2009). In Realist literature, energy is often simply the object of state competition (Ikenberry 1986; Colgan 2013; Hill 2004) and control over energy is one more asset that can be counted towards aggregations of power over other nations. The traditional study of geopolitics falls within a neo-Malthusian or Realist paradigm characterised by what Hoffmann (2018: 43) calls an ‘a priori assumed and under-specified competition over territory and scarce resources’. Instead, he calls for a geopolitics of energy
which goes beyond the pessimistic expectations of Realists about the inevitability of conflict, the overly optimistic expectations of trade and cooperation by Liberals and Marxists’ expectations of neocolonial domination and resource extraction (Hoffmann 2018).

Goldthau and Sitter (2015: 23) note how the major juncture points in world politics over the last four decades reveal the importance of energy in driving events and influencing their trajectories: ‘the end of the post-World War II economic boom (a function of OPEC flexing its muscles in 1973), the Iranian revolution in 1978–9 (a reaction to US and UK attempts to keep control over oil-rich Persia), the collapse of Russia in 1998 (a result of low oil prices) eventually bringing Putin to power, or the 2014 Ukraine crisis (which triggered the EU’s integration effort towards an energy union)’. It is also the case that the global debt crisis was triggered by the recycling of petrodollars to least developed countries (LDCs) to address balance of payments deficits. Richer countries also sought to offset rising oil bills through expansion of exports such as military hardware and nuclear technology. The exercise of power demonstrated by OPEC countries over the world’s oil supply produced a legitimation crisis of sorts for global managers that needed to diffuse calls for a New International Economic Order (NIEO) which included fairer terms of trade and commodity prices, better regulation of transnational corporations (TNCs) and higher levels of aid (Williams, M. 1994). One effect of the oil crisis was then to produce a ‘realignment of forces’, nudging Western governments towards acceptance of some elements of the NIEO (Odell 1981: 276). Odell (1981: 276) notes: ‘The oil exporters’ oligopolistic behaviour seems certain to produce a significant effect on other groups of nations hitherto excluded from a “say” in running the system.’ Aid and the arms trade were mobilised to ensure access to energy (Hammarlund 1976).

It also had domestic political repercussions on energy choices. Deliberate and active oversight of solar in favour of nuclear in the USA, despite the findings of its own task force and the obvious benefits for LDCs, is explained in relation to the dependence it propagates on Western technology (Hammarlund 1976: 184–5). It also helps to reduce internal tensions: ‘Inflationary pressures, unexpected increases in capital costs, long construction delays, and growing public opposition have prompted a wave of cancellations and suspensions by energy utilities. In order to recoup their massive investments and offset higher payments for oil imports, capitalist states have responded by encouraging export sales to the Third World’ (Hammarlund 1976: 186). Sales of nuclear technology were promoted through subsidies, no or low interest loans, preferential pricing of fuels and reprocessing services. Particular targets were those authoritarian regimes that ‘can more easily
ignore cries of public opposition’ (Hammarlund 1976: 187). These events can be interpreted in a number of ways.

More liberal political economy accounts show how the history of international energy can be understood only if political, institutional, social and economic factors, all inextricably linked, are attended to. Such accounts focus on nation states and domestic public and private energy companies to furnish a ‘primarily institutional and political’ account of the political economy of energy (Clark 1990: 4). Wars, depressions and crises, in which energy becomes an additional battleground for inter-state rivalry, form the backbone of the analysis where crises of supply and price determine the rise and fall of power. For example, it shows how an oligopoly of multinational oil companies backed by US and British state power ruled the oil industry for the bulk of the first half of the twentieth century before having its power decentred by an oligopoly of oil-producing states bringing about ‘sudden change in energy centres of power and the consequences for production, pricing, national security and so on’ (Clark 1990: 6). Clark (1990: 365) concludes his book on The Political Economy of World Energy reflecting that the political economy of world energy in the twentieth century suggests that ‘[t]he world’s nations and peoples experienced diverse and complex energy transitions. The locus of national and world power constantly shifted. Power blocs rose and decayed.’ Yet it was also attentive to the transformation of (domestic) energy mixes and energy policy formation, reifying the division between domestic and international politics, but suggesting points of engagement with transition debates. Indeed, the book suggests, ahead of its time perhaps, that ‘the real energy crisis is one of overconsumption of fossil fuels and inexcusable neglect of renewable energy and conservation’ (Clark 1990: 7).

Many such liberal institutionalist accounts, inspired by the framework of transnational relations developed by Nye and Keohane (1972) to understand world politics, were written in the shadow of the OPEC crisis, and so shifts in the oil regime and the politics of cartels and conflict assume centre stage (Choucri 1976; Clark 1990). Recognising that the energy system has undergone transformations that have led to new centres of power emerging globally, many emphasise interdependence whereby even the most powerful countries struggle to exercise unilateral control and the welfare of each country becomes sensitive and vulnerable to the actions of others (Hammarlund 1976: 154; Choucri 1976). This line of thinking came to prominence in the wake of the OPEC crisis of 1974, which exposed the economic insecurity of the capitalist core of the global economy.

The normative project is to build energy co-operation around an energy regime to manage interdependence around shared interests, vulnerabilities and cognisance of structural asymmetries and inequalities in co-ordinating responses (Wilson 2015).
This leads to a paradox: ‘No state alone can impose its conception of order or control upon the others. Yet, any successful coordination of behaviour can only be undertaken in the belief that it enhances national autonomy. Only through the pursuit of autonomy is coordination possible politically, and only through some coordination can the dispute over control be resolved’ (Choucri 1976: 192). The aim is to meet national energy requirements ‘without generating undue economic and political dislocations’ (Choucri 1976: 195). Choucri (1976: 211) suggests that ‘no matter what sources of energy will be used in the future, in whatever mix or proportion, the management of interdependence will remain the most critical challenge confronting all nations’. In more recent iterations, Liberal perspectives have engaged with the ‘regime complex’ around energy (Colgan et al. 2012): the interrelations between different actors and institutions active in the energy domain, and the ways and means of strengthening global energy governance (Van de Graaf 2013; Goldthau and Witte 2009; Cherp et al. 2011).

More Marxist-inspired renditions (Bromley 1991; Rees 2001) emphasise energy resources (particularly oil) as the focus of imperialism and exploitation. Bromley (2005: 227) suggests, for example, that ‘[c]ontrol of oil may be seen as the centre of gravity of US economic hegemony’. Other Marxist accounts have sought to project energy policy scenarios for capitalist society (Hammarlund and Lindberg 1976). Despite some attempts to diversify energy supply, the unwavering commitment to productivist growth necessitates a foreign policy guided by the need to secure and then protect predictable supplies of energy for domestic growth. Though the need to reduce dependence on imports was noted, the logical conclusion that demand needed to be reduced was not heeded. Indeed, most consuming nations increased their dependency on foreign imports in the wake of the oil embargo (Hammarlund 1976). Employing a range of Marxist lenses, recent work by Di Muzio and Ovadia (2016) and Di Muzio (2015) explores the respective relationships among energy, capitalism and world order and energy, social reproduction and world order, in which issues of energy transitions are just one feature (Newell 2016).

Whatever the limitations or historical specificities associated with these diverse literatures within IR and political economy, they have inadvertently helped to provide the basis of a more global, historical and political framework for thinking about transitions. As Choucri (1976: xiii) puts it: ‘The energy problem is basically a political one- it emanates from disputes over who controls energy transactions, what the rules of the game will be, who gains and who loses, and at what costs to whom.’ Their contribution is to treat energy politically where previously it had been understood as overwhelmingly economic in nature. Despite these advances, however, by way of indictment of the debate about energy in the discipline, Van de Graaf et al. (2016: 4) maintain that Ernest Wilson’s (1987: 126) claim that work on
the international dimensions of energy is ‘largely descriptive, atheoretical and noncumulative’ remains valid today. Against this background, how global environmental change and climate change in particular might alter and be changed by global energy politics has received even less attention (Falkner 2014; Kuzemko et al. 2015): an issue I address in each of the following chapters in the section on ‘ecologies’. Recent work which seeks to understand how energy transitions impact upon the global political economy promises to address another neglected area of the interface between IPE and energy (Goldthau et al. 2019).

There is clearly, then, an urgent need to bring existing theoretical and conceptual tools from different strands of political economy to bear on the question of transitions to a lower carbon economy, while at the same time revisiting and sensitising these approaches to what is different and unique about energy and its history, ecology and political economy. I argue here that insights from the literature in critical IPE, in particular, can provide a source of clues as to the prospects of steering the forces of human history in more sustainable directions – in particular towards the decarbonisation of the global economy. This serves to highlight vulnerabilities, weak spots and active agents of change that will need to be enrolled in any project of transformation beyond more narrowly conceived sociotechnical transitions. These need to take seriously the centrality of the relationship between energy and growth, energy and statehood and the role of energy in producing different forms of capitalism, as is required again now at this historical moment. The need is urgent because of the mutual neglect of energy questions in (international) political economy and the equally problematic neglect of politics in innovation studies and economic history, which need to be combined to enrich our understanding of which combinations of institutions, actors and social forces, finance and technology are best placed to address these challenges of energy transformation.

Political economy analysis is often strongest and best at explaining why radical change does not come about. With reference to the structural power of key state, corporate and institutional actors and their control over the means of production, their hold over finance and technology in the contemporary global economy and power of elites to project and maintain the status quo as normal and given, it is strongest when explaining why business as usual prevails and radical alternatives are accommodated and diluted, crushed, de-legitimised or ignored (Gill 2008; Levy and Newell 2002). More challenging is to look back historically and infer lessons for the present about when radical, disruptive and socially progressive change has been possible before, and could be again, in the face of sustainability challenges.

In building a GPE account, it is worth speculating what classic political economists such as Smith, Ricardo, Marx, Polanyi and Mill would have made of the
debate about energy transitions. Smith (1776 [2014]), rather like many mainstream economists, might be confident that the laws of supply and demand will see to it that price signals will indicate scarcity and that behaviours (and finance) will correspondingly realign. If oil is in scarce supply, prices will go up and producers and consumers will be naturally drawn to other sources. In this regard, a famous bet took place between Paul Ehrlich, author of the book Population Bomb (1975) coming from a neo-Malthusian perspective, and the economist Julian Simon. Ehrlich feared that a growth in population would deplete natural resources. Simon counterintuitively argued that population growth would actually make resources more abundant because of long-term changes in income, as well as the impact that technology and human ingenuity would have on the availability of resources. In September 1980, Simon challenged Ehrlich to a bet on resource depletion. Simon told Ehrlich he could choose a group of raw materials that he thought would become less abundant over the next decade. If the real prices of those materials increased over that time, then Ehrlich would win the bet. In the period between September 1980 and September 1990, population rose by 873 million people, and all five commodities that Ehrlich selected declined in real price, with an average drop of 57.6 per cent (Robbins et al. 2010: 29).

Likewise, Smith would have approved of Sir Nicolas Stern’s emphasis in his report on The Economics of Climate Change that markets can be made to work in combatting climate change (Stern 2006). Stern famously described climate change as the world’s greatest market failure. The failure is to internalise externalities. Pricing, therefore, is the answer. This tradition, which dates back to the work of economists such as Coase and Pigou, has lent intellectual weight to much of the drive towards carbon trading and markets. For Ricardo (1817), trade would be key, and he would be fascinated by debates about embedded carbon, trade and energy, the potential for an ‘energy’ round and the politics of relations between energy exporters and importers (Kassler and Paterson 1997). The need for specialisation and the new divisions of labour in the energy economy (Lachapelle et al. 2017) would also be unsurprising to him, though he would reject ecological critiques of how the narrow pursuit of comparative advantage leads to and justifies damaging forms of internationalised production and exchange (Newell 2012).

Marx would be unsurprised, of course, by capitalism’s destructive nature and failure to recognise that all wealth in the end derives from the soil and the worker (Marx 1974: 475). He would look with a combination of awe and horror at the constant disruptions to production and their destabilising effects on the social systems in which production operates. Energy features heavily in Marx’s analysis of capitalism and some writers have sought to construct an account of Marx’s ecology (Bellamy Foster 1999). Marxists have drawn upon ideas about the
‘metabolic rift’ and laws of entropy and thermodynamics to counter prevailing economic myths about the role of energy in the economy (Georgescu-Roegen 1971; Altvater 2006). But Marx would also mock debates about a ‘just transition’ absent of a serious discussion about class struggle and the relationship between capital and labour. He would posit that unless and until the means of production are held by the proletariat, any prospects of a just, let alone sustainable, transition would be remote indeed. He would share Abramsky’s view that ‘[a] discussion of energy cannot be separated from a discussion of capitalism, crisis and class struggle’ (Abramsky 2010: 11). He might be more interested in debates about energy democracy and struggles to spark a ‘worldwide energy revolution’ to re-common energy. He would echo Abramsky’s (2010: 10) claim that ‘[a] class analysis of energy helps to situate the contemporary evolution of the energy sector in general, and the expanding renewable energy sector in particular, within systemic dynamics’. And he would be sympathetic to the claim that ‘the transition process to a new energy system is, in effect, the next round of global class struggle over control of the means of production and subsistence’ (Abramsky 2010: 10).

But, equally, Marx might be dismayed by the ways in which bosses and trade unions are often uniting in opposition to (ecological and social) transformation, more preoccupied with gaining short-term concessions than moving beyond capitalism. Polanyi (1957 [1944]), meanwhile, would want to see a re-embedding of energy markets within broader frameworks of social control to tame the more destructive elements of market society. This might include better regulation of ‘climate capitalism’ (Newell and Paterson 2010), or a more ambitious programme of social reform. These insights about the role of shifting historical social forces have informed a range of approaches drawing on different strands of Marxism to understand climate politics (Koch 2012; Mann and Wainwright 2018; Malm 2016) and the carbon economy in particular, and to a lesser extent energy politics (Huber 2013; Di Muzio 2015; Newell 2018).

The deeper, more explicitly political, global and historical analysis proposed here is vital to allowing us to move beyond glib statements about ‘green growth’ and ‘win-win solutions’ without probing the conflicts, trade-offs and compromises that are implied by such fundamental restructuring of the economy and the relations of power which will determine which pathway is chosen. The ‘incumbent’ regime of existing actors and interests that benefit from ongoing reliance on a fossil fuel economy and that have played such a decisive role in the development of capitalism over the last century will not give up their position easily (Newell and Paterson 1998; Newell and Johnstone 2018); nor, in all likelihood, will governments and international institutions that have, so far, shown little appetite for initiating structural change in a context of financial austerity. Since energy use, in particular,
is closely correlated with growth, there is tremendous political sensitivity around proposals to transform its provision and distribution.

### 2.6 Historicising the Political Economy of Energy Transitions

History teaches us nothing but just punishes us for not learning its lessons.

*Vasily Kliuuchevsky (quoted in Shmelev and Popov 1989).*

As we will see throughout this book, the historical dimension of energy transitions is important for understanding both the evolution and the solidification of lock-in around a fossil fuel complex, but also as a source of insights about disruption (Geels 2018; Kivimaa et al. 2021) and creative or (self)-destruction (Wright and Nyberg 2015). An account of when things have changed as a way of understanding constellations of power and their limits can inform an enquiry into the possibility of accelerating energy transitions at this historical conjuncture. This helps to locate contemporary (and historical) energy transitions as a product of a particular configuration of social and class forces of production. Antonio Gramsci (1971) once said: ‘The starting-point of critical elaboration is the consciousness of what one really is, and in “knowing thyself” as a product of the historical processes to date, what has deposited in you an infinity of traces, without leaving an inventory.’

As Edward Said (1978: 25) then goes on to observe, ‘[t]he only available translation inexplicably leaves Gramsci’s comment at that, whereas in fact Gramsci’s text concludes by saying, “therefore it is imperative at the outset to compile such an inventory”’.

There are then important questions about *when* and *how* transitions can come about, exploring their historical, economic, political, social and cultural enabling conditions. This includes debates about their temporality and whether they can be accelerated and, if so, over what sorts of time frame (Smil 2016; Sovacool 2016; Simms and Newell 2017) as well the spatial (Broto and Baker 2018) and geographical (Bridge et al. 2013) dimensions of transitions noted earlier. As Roberts et al. (2018) note, the obvious need for acceleration has created an urgent debate over whether and how the necessary changes can happen quickly enough. Many scholars offer pessimistic answers. Smil (2016) makes a particularly compelling historical argument that transitions in energy systems are ‘long and arduous’. If they are to succeed at mitigating climate change, therefore, the pace of transitions to low carbon energy systems must somehow differ from historical precedent, as the IPCC’s (2018) SR15 made very clear. The report argued that such transitions have been observed in the past within specific sectors and technologies, but that the geographical and economic scales at which the required rates of change in the
energy, land, urban, infrastructure and industrial systems would now need to take place are larger and have no documented historic precedent (IPCC 2018).

This will require an acceleration of the pace of change. There is some reason for hoping that such an acceleration could be plausible. Past energy transitions have been triggered by a largely emergent combination of policy efforts, economic shifts, technological developments and other factors. While currently ongoing low carbon transitions also benefit from emergent technical, economic and cultural developments, however, they are also being actively pushed by policymakers on an international level, in a way unlike any other energy transition on historical record. Sovacool’s (2016) list of ten rapid energy transitions, some of which went from a 1 per cent to a 25 per cent market share in just a few years, shows that this kind of acceleration can achieve impressive results. This has provoked significant debate on whether Sovacool’s relatively small-scale examples can have a bearing on the global energy transitions necessary to mitigate climate change (Smil 2016; Grubler et al. 2016).

What, if any, historical precedents are there for the rapid and disruptive change to existing ways of organising the economy, technology, finance, politics and society in ways which brought about positive change that might be useful for analysis and praxis at this historical conjuncture? History provides plenty of examples of violent periods of war, revolution, social upheaval and rapid, but socially regressive transitions (arguably Reganomics and Thatcherism or contemporary alt-right populist politics) involving the reorganisation of the economy and social contracts or rapid lock-in along unsustainable lines (Fordism or the dismantling of rail and urban mass transit systems to build the infrastructures for cars or the rapid expansion of mass aviation). Or of environmentally beneficial rapid transitions undertaken in socially regressive ways such as the ‘rapid decarbonisation’ transition from coal to gas in the UK in the 1980s (the ‘dash for gas’) which sparked a miner’s strike and widespread social unrest, but was described as ‘among the most globally significant of any national decarbonisation’ (Pollitt 2012: 135; Turnheim and Geels 2012). The same was true of the Supreme Court ruling in India in 2002 which insisted on a tight timeline for the adoption of compressed natural gas in taxis and rickshaws in Delhi before the infrastructure was in place to meet demand for the alternative fuel, leading to widespread disruption and protest. These examples illustrate both how state power can de-stabilise and deliberately phase out whole sectors of the economy when the will is there to do so, but also the socially regressive ways in which this can be done. So, does history also offer any lessons about the scope for socially positive rapid transformations, a progressive version of Naomi Klein’s (2007) ‘shock doctrine’ perhaps of when crises create opportunities to introduce more ecologically and socially sustainable practices and systems?
Seeking to historicise a discussion of rapid socio-environmental transformations is useful and necessary, therefore, for the reasons given here, but it does bring with it a number of analytical and political challenges. Case selection is often biased towards success, and not the far greater number of failed transitions. In this regard, I follow the recommendation of Fouquet and Pearson (2012: 3) that ‘the choice and selection of historical cases ought to be driven by a diagnosis of the type of challenges that we currently face’. Additional challenges include, firstly, seeking to combine rapidity with large-scale transformations. This limits the pool of relevant cases significantly since most transformations in systems such as energy are thought to unfold over decades, if not centuries. Smil (2008: 2) writes that ‘all energy transitions have one thing in common: They are prolonged affairs that take decades to accomplish, and the greater the scale of prevailing uses and conversions, the longer the substitutions will take.’ On this basis, he cautions against ‘unrealistic expectations concerning the pace of future energy transitions’ (Smil 2016: 194). The work of Carlota Perez (2002) on finance capital and technological revolutions similarly shows ‘waves of creative destruction’ rise and break over decades or centuries in terms of unsettling old orders and delivering technological revolutions. Think of the industrial revolution, the age of steam and railways, or Fordism and auto-mobility.

History shows that energy system transitions, in particular, are rare events whose complex and long-drawn-out processes are often decades in the making and can take centuries to fully unfold (Fouquet and Pearson 2012:1), even if there are intense periods of acceleration in the deployment and uptake of particular technologies, as we seeing with solar PV. The fall in the use of biomass and coal and the rise in oil were all transitions that lasted seventy to ninety years. The period in which innovations go from initial commercial success to 2 per cent market share can take over two decades. New systems tend to face the ‘lock-in’ or ‘path dependency’ of existing systems. As Smil (2016: 195) points out: ‘It’s taken between 50 and 70 years for a resource to reach a large penetration. When you look at the money, the infrastructure, the regulation, the technologies, it takes many decades for any fuel source to make a large impact.’ Electric vehicles came before petrol cars, while early experiments with solar energy can be dated to the 1950s. He further claims that ‘global energy transitions have been always gradual, prolonged affairs’, particularly so in large nations whose high levels of per capita energy use and whose massive and expensive infrastructures make it impossible to greatly accelerate their progress even if there is resort to some highly effective interventions (Smil 2016: 195). Fast transitions, when they occur at all, are considered anomalies, limited to countries with very small populations or highly specific contextual circumstances that strictly condition any lessons that can be derived
from them. For example, the decision to switch the British Navy’s fuel from coal to oil prior to the First World War was a key trigger for the growth of the UK oil industry and, post-Cold War, Cuba’s rapid energy shift was the result of loss of access to cheap Soviet oil. In general, the only technologies that go faster are those that are readily substitutable for existing technologies. This time, transitions that take decades or centuries have to be radically accelerated given diminishing available carbon space and that generates a peculiar set of issues and dilemmas.

There are nevertheless challenges to the mainstream view of energy transitions as long, protracted affairs. As Sovacool (2016: 203) notes:

[M]any transitions – at varying scales and sectors – have occurred quite quickly – that is, between a few years and a decade or so, or within a single generation. At smaller scales, the adoption of cook stoves, air conditioners, and flex-fuel vehicles are excellent examples. At the state or national scale, almost complete transitions to oil and electricity in Kuwait, natural gas in the Netherlands, and nuclear electricity in France took only a decade, roughly, to occur. [I produce] ten case studies of energy transitions that, in aggregate, affected almost one billion people and needed only 1–16 years to unfold. Clearly, this evidence suggests that some energy transitions can occur much more quickly than commonly believed.

These disputes among academics about the historical and temporal dimensions of transitions are compounded by the politics of how we define and measure rapidity and how we typologise transitions. Sovacool (2016: 211) gives the example of Brazil’s transition to flex-fuel vehicles, which ‘arguably, took a year (from the start of the national program to large-scale diffusion), more than twenty years (from the first invention of a FFV in 1980), almost thirty years (from the start of their national ethanol program), or more than eight decades (from the first invention of a Brazilian engine capable of using ethanol in the 1920s)’. Likewise, you can date the introduction of wind turbines to the 1880s and solar PV to 1954 (Fouquet 2016a). In dealing with the temporal dynamics of transitions, there is always a danger of comparing ‘apples and oranges’ (Grubler et al. 2016), of drawing parallels, for example, between the slow dynamics of ‘grand transitions’: global primary energy transitions (from one fuel to another) to more rapid national transitions. In the case of the latter, even sceptics such as Smil (2016), concede that rapid transitions over just a few years are possible. The common characteristics of rapid transitions, according to Grubler et al. (2016), are where a new and well-established technology simply substitutes for an old one (clean cookstoves, LPG, FlexFuel cars), where substitute technologies have been previously used in other markets, benefitting from the experience of early adopters and where the scales, either national or sub-national are relatively small, and finally where the technologies offer high tangible benefits for adopters such as health (cookstoves), flexibility (FlexFuels), cost and convenience as well as benefitting from well-designed public
policies. These are not representative, they hasten to add, of the more pervasive energy system transitions that have been the focus of historical studies or of the climate and sustainability scenario literature (Grubler et al. 2016). In sum, the duration of transitions increases with complexity, more so when we are talking about ‘systems of systems’ (Grubler et al. 2016).

Secondly, a note of caution is appropriate about the unintended political consequences of invoking urgency as a criterion for transitions. The demand for rapidity can give rise to a series of ‘urgency dilemmas’ amid claims about the need to suspend democratic politics as usual. This can take the form of overriding planning decisions (such as that of Lancashire council in the UK against fracking) or speeding them up (to accelerate the adoption of nuclear invoking the urgency of transitioning to a low carbon economy, for example) given the need to accelerate the adoption of technologies labelled low carbon by policy elites. Clarion calls of a ‘global emergency’, however well intended, can pave the way for ‘exceptional’ actions, on the part of states in particular, which bypass the need for regular democratic scrutiny. Bromley (2016: 170), for example, argues that ‘decision-makers cannot wait for a climate catastrophe to consolidate public opinion and political will, so a way must be found to frame imminent disaster alongside extraordinary interventions that will save the day’. Urgency can be used to trump and supersede political conflict, what has been referred to as ‘post-politics’ (Swyngedouw 2010) and accelerate the diffusion of controversial technologies (such as geo-engineering or negative emission technologies), or to suspend forms of political engagement that are incompatible with business as usual politics and economics on the basis that we have to ‘go with the grain’ of existing actors and institutions.

Related to this is the real danger that an emphasis on urgency and, by definition, crisis management frames responses in terms of top-down interventions from elite actors, that is, those with the power, resources and control over finance, production and infrastructures, or that can call upon the coercive powers of the state. For example, the declaration of climate emergencies by local authorities around the world is, on the one hand, a welcome recognition of the gravity of the threat posed by climate change, coming on the back of the IPCC Special Report on 1.5 degrees mentioned earlier (IPCC 2018). Some councils in the UK and France have organised citizen assemblies to deliberate on appropriate local responses. Shifting budgetary priorities and reversing decisions which lock in carbon (cancelling infrastructural developments such as proposed airport expansions, for example) might all be welcome. Providing a blank slate for governments to impose their preferred versions and visions of low carbon futures, however, would be to open the possibility of regressive interventions validated by the emergency.
This scenario potentially diminishes scope for more plural, bottom-up, inclusive and deliberative pathways to sustainability where transformations are cultured and follow an ethic of ‘care’ rather than ‘control’ (Stirling 2011, 2014).

A further consideration in case selection is that by consciously cherry-picking from history examples of sudden and disruptive change, we potentially run the risk of reifying and reinforcing disabling accounts of change wherein the key processes and institutions are incumbent ones controlled by powerful actors. The challenge is to recognise this tension and ensure that analogous cultural shifts and contentious politics are included in the analysis, to ensure that we recognise that instances of decisive change and leadership by powerful actors often come on the back of years, if not decades, of cultural change and shifts in values and norms, politics of protest and agitation when explaining and attributing agency. In this regard, Sovacool (2016: 204) quotes O’Connor: ‘Big transitions are the sum of many small ones. Looking at overall energy consumption will miss the small-scale changes that are the foundation of the transitions and the cumulative effects of changes in practice.’

Looking for primary drivers of major disruptions inevitably reveals a partial and incomplete picture. Social scientists and historians tend to overlook daily ‘micro-disruptions’, focusing instead on the ‘big bang’ of reflective agency (Hopf 2018). It is indeed the case that ‘major transitions’ are only easily identifiable because of a series of ‘minor transitions’ that have occurred in a concerted manner. This underscores the point about the confluence of practices of governance, finance, mobilisation and culture as key to enabling the likelihood and probability that transitions can be accelerated. Indeed, actors and their agency need to be looked at in relation to one another rather than in isolation. As Scoones et al. (2015) show, while green transformations can be more state-led, market-led, technology-led or citizen-led, in reality they converge, compete and reinforce one another. This is not a search for a mono-causal big-bang theory of change, therefore. The changes are always multidimensional. As Sovacool (2016: 205) shows: ‘In order to counteract path dependence, inertia, and lock-in, scholars looking at transitions theory have argued that truly trans-formative change must be the result of alterations at every level of the system simultaneously’ from technology niches to regimes and the broader landscape which shapes them.

Appreciating the tensions inherent in the dynamics of rapid change does not absolve us of the responsibility for engaging concretely, as well as analytically, with the pressing need for accelerating transitions towards sustainability and addressing the consequences and injustices of current patterns of ‘slow violence’ (Nixon 2011) and near-term anticipated impacts. Likewise, it is critical to acknowledge the grave consequences of failing to adopt a transition pathway compatible in scale and speed with meeting the targets of the Paris Agreement on climate change. These include
a world of worsening climatic upheaval, in which positive feedbacks trigger irreversible processes of environmental change whose impacts disproportionately fall on low-income and marginalised groups.

Thirdly, there is the issue of the lack of relevant historical precedents for conscious transitions driven by environmental imperatives. Previous shifts from coal to oil, or around transitions in transportation towards private transport under Fordism, or towards public sanitation systems over open sewers, were driven by the possibility of making more money, producing efficiency gains or dealing with major crises (health and disease with sanitation) in the case of the OPEC oil crisis driving investments in renewable energy and energy efficiency. In Fouquet’s (2010) review of fourteen past energy transitions, he finds that for new sources to become dominant, in each case the service it provides has to be cheaper than the incumbent energy source, as well as offer enhanced characteristics (such as ease of use, exclusivity, cleanliness or status). Even if currently not framed this way by incumbent actors, debatably, with sustainability we face the very real prospect of having to produce and consume less, or to invest in pathways that may be less cost-effective, profitable or convenient (at least in the short term) than the alternatives with which they are competing and which, therefore, make them potentially less appealing to investors. Ediger and Bowlus (2018: 2) suggest: ‘The two transitions from one dominant source to another – wood to coal and coal to oil – occurred over several decades and when overall energy demand was growing, but energy demand growth is not guaranteed to drive a future transition’.

On the other hand, and more positively, as Kern and Rogge (2016) argue, it is precisely the gravity of the situation we now face with climate change that means historical parallels are less useful regarding the drivers of energy and other transitions, since never before have we faced a situation in which one of the primary rationales for change is planetary survival. Hence politics may trump economics as usual in the context of public backing for more rapid and far-reaching transitions than have been contemplated to date. Kern and Rogge (2016: 13) note:

The key reason for our optimism is that historic energy transitions have not been consciously governed, whereas today a wide range of actors is engaged in active attempts to govern the transition towards low carbon energy systems . . . [T]he 2015 Paris agreement demonstrates a global commitment to move towards a low carbon economy for the first time, thereby signalling the required political will to foster quick transitions and to overcome resistance.

In a report on ‘transformation points’, the Centre for Alternative Technology (CAT 2019:1) argues:

The Paris Agreement is nothing less than a mandate to transform and move the global energy system into a new state supporting economic prosperity and sustainable development using zero-carbon technologies. System transformations of this scale are possible and
have happened before. Mobile phones, for example, soared from virtually zero to almost full coverage in less than two decades. A slower transformation on a much larger scale is already happening in renewable electricity, where the costs of some sources have dropped exponentially over the last two decades, making renewables competitive with incumbent technologies. In this process, a transformation point marks the moment when a previously novel technology, behaviour or market model achieved critical mass, took off, and became the new normal.

The authors argue that zero carbon technology deployment will typically pass through the four following stages: 1) an *initiation phase* where a technology demonstrates feasibility at a project level; 2) a *development phase*, which overcomes the main barriers to adoption by putting certain building blocks in place, then reaches a moment of critical mass (the ‘transformation point’), where the previously new state begins to be considered the new norm; 3) a *take-off phase* where the adoption rate increases rapidly before levelling off such that further adoption still requires effort after this point, but this decreases over time until the final phase; 4) a *completion phase* involving continued effort to reach completeness and maximum market penetration. It is notable, however, that, in this framing, transformation is about the enabling conditions for technological take-off and not about disrupting or challenging dominant power relations.

Nevertheless, targeted policies can aid transformation in some countries: To facilitate the transition in the renewable energy sector, a small number of ambitious actors, in particular governments introducing policies such as feed-in tariffs, took the lead, and were followed by a critical mass of early movers (Sterl et al. 2017). Key to reaching the transformation point for mobile phones was the perceived advantage of the new technology, relative ease of access and scalability compared to the incumbent land-line technology (which never penetrated many parts of the world due to high infrastructure costs). The key characteristics of an ‘S-curve’ of new technology dispersion and adoption are the rate of increase (speed) and the maximum achievable level (scale). Even after the transformation point, some effort (e.g. policy support or financial incentives) may be needed to speed up take-off and completion phases and to avoid sliding back to the old system. Another important characteristic of the S-curve transformation is that the rate of change accelerates. The system changes slowly in the beginning but speeds up over time. To achieve the aim of full decarbonisation, a concerted and far-sighted effort will be needed to initiate the transformation (as has happened in the past for the power sector) and to then keep the transformation going at the necessary speed (Rockström et al. 2017). Resonating with the historical reflections referred to already, one driving force will be the considerable advantages associated with the transformation to a zero carbon society, such as co-benefits in cost, comfort and convenience that are already starting to appear (Carbon Action Tracker 2019).
To put it bluntly, the Stone Age did not end because we ran out of stone. As Ediger and Bowlus (2018: 2) argue: ‘The abundance of the new source has not necessarily determined the pace of its adoption, nor has the remaining availability of the existing source necessarily determined the rate of its decline.’ Whereas previous transitions were more ‘opportunity’ driven, the low carbon transition might be more ‘problem’ or ‘threat’ driven. Likewise, ‘[w]hile past transitions may have been rooted in abundance, future ones may involve scarcity’ (Sovacool and Geels 2016: 235). The driver may be less the discovery of new fuels, the availability of new services or drops in the cost of technology, though each of these may play an important role. It may rather be the conscious redesign of the economy along lower carbon lines and the managed decline of existing industries, not because they are no longer profitable or able to meet consumer needs, but because they are pushing us beyond ecological limits.

The accelerated and deliberate decline of whole and very powerful industries for reasons of sustainability, as we are witnessing with the demise of coal in particular (Caldecott et al. 2017), suggests that we are entering a new terrain of transition. Transitions are not organic and non-linear, but have to be imagined, designed, financed, constructed and socially accepted. All this requires political work which can set and support the direction of change. In this sense, there is increased scope for what Bromley (2016) calls ‘extraordinary interventions’. Drawing parallels with the political and industrial landscape prior to the Second World War, he suggests that the conditions are amenable to increased rapidity in transitions. He notes the fact that research and development (R&D) policies of leading industrial nations are supportive of strategic and rapid innovation, including the increasing popularity of Green New Deals, that there is a support base for strategic intervention across a range of public and private actors, and that zero carbon technologies are already cost-competitive in many jurisdictions.

This transition will also unfold in a more globally integrated world than previous transitions where experimentation, diffusion and collaboration around technology and production are more globally organised and co-ordinated, even if it is a sub-set of states that wield disproportionate power over the direction of change which they can drive, at speed, through the global economy. The falling price and availability of solar PV is a case in point. Unlike previous transitions, it is also more likely that we are looking to a multitude of energy sources to meet different energy needs through different pathways, such that the standard metric of 50 per cent market share for global energy transitions is less relevant. The adage that ‘necessity is the mother of all invention’ seems more appropriate. And if there is anything which most transition scholars can agree on, it is that transitions are non-linear processes,
so surprises and unintended consequences are one of the few things that are certain (Sovacool and Geels 2016). Indeed, Fouquet (2016a) highlights the ability of energy price shocks to create ‘tipping points’ as well as ‘lock-in’. The soaring price of coal drove many countries to invest in hydropower during the First World War, while the oil shocks in the 1970s led many economies to reduce their dependence on oil.

I have noted many of the challenges and limitations associated with trying to project into the future based on a (necessarily selective) reading of the past. The dynamics may be different going forward and questions of sustainability bring with them particular challenges around urgency and the need for a fundamentally different model of economic development that goes beyond replacing one mode of accumulation and regulation for growth, with its associated technologies, flows of finance and models of production, for another. For this reason, as Fouquet and Pearson (2012: 3) put it, ‘past energy transitions may not be the best analogies for a future low carbon energy transition’. As Sovacool (2016: 210) suggests: ‘Future transitions may also become a social or political priority in ways that previous transitions have not been—that is, previous transitions may have been accidental or circumstantial, whereas future transitions could become more planned and coordinated, or backed by aggressive social movements or progressive government targets.’

For example, unlike earlier transitions driven primarily by price or an abundance of resources, future ones may be driven by scarcity and the unaffordability of resources or stranded assets and un-burnable carbon. In terms of the knowledge base, scientific consensus and broad policy toolkits for addressing these issues that are now available – production tax credits, feed-in tariffs and renewable portfolio standards that can hasten the adoption of preferred technologies – a positive enabling environment may be said to exist. Despite this, transitions may well be incremental, cumulative, messy and multidirectional for the most part. As Sovacool (2016: 211) suggests, ‘most energy transitions have been, and will likely continue to be, path dependent rather than revolutionary, cumulative rather than fully substitutive’. But, as I have shown here, this does not exclude the possibility and imperative of rapid disruptive change over shorter time frames where shifts in governance, financing, mobilisation and culture of the sort described above coincide, overlap and drive one another. I concur with Grubler (2012: 8): ‘History does not preordain the future, but it is the only observational space available from which to draw lessons from and to inform policy models and makers of what it takes to initiate and sustain a much-needed next transition towards sustainability.’

An approach grounded in historical materialism lends a more historical perspective to the debates about precedents for and the possibilities of transitions and
transformations in society and the economy, and not just in (re)alignments of technology and social practice. This is consistent with an historical materialist approach to studying an emergent world order ‘in terms of its economic, political and socio-cultural dimensions, with a view to its emerging contradictions and limits and the possibilities these imply for different collectivities’ (Gill 1993: 16). Gramsci distinguishes this approach to showing how ideas and material conditions are always bound together, from a more reductionist ‘historical economism’ which reduces all explanations to the material sphere (Gramsci 1971). This approach can build on previous histories of transitions which emphasise factors such as the role of prices, science and human capital (Fouquet and Pearson 2012; Grubler 2012; Pearson and Foxon 2012; Allen 2012). But rather than view the technological and the social context which supported particular transitions in isolation, the emphasis here is on identifying the underlying political, historical and material factors that enable large-scale transformations to take place, which will inform our understanding of the contemporary global politics of energy transitions. This is critical to appreciating the terrain upon which competing social forces will contest the future organisation of the economy in a carbon-constrained world, based on their role in shaping and resisting previous political change and how they have engaged with the challenge of an energy transition to date (Podobnik 2006), given that the scale of the challenge is often likened to that of creating a new global industrial revolution.

2.7 Ecologising the Political Economy of Energy Transitions

Layered upon the globalised and historical account of the political economy of energy transitions described so far in this chapter, we need to bring in an ecological dimension in recognition of the fact that all energy pathways have ecological consequences and their very viability in the long term will be a function of their ecological sustainability. So, what does ecological political economy add to an historical GPE account? If it is to have contemporary value and application, political economy has to be able to speak to the ecological crisis we now face.

Bringing in political ecology can help to ecologise a GPE account of transitions and address its potential to overemphasise economism (Lawhon and Murphy 2012). The core questions that political ecologists ask about access, allocation, property regimes and justice are as pertinent to energy as to other resource arenas where these insights have been applied (Robbins 2004; Peet et al. 2011). Foundations of ecological political economy can be found in the work of Gale and M’Gonigle (2000), Barry (1999), Katz-Rosene and Paterson (2018), Moore (2015b), Bookchin (1980) and Newell (2012, 2019). In its make-up, it often
combines elements of different green thinking (social ecological, socialist and Marxist), as well as feminist and Marxist political economy: combining attention to social and historical processes of exclusion and exploitation with a critical account of the state and capitalism in terms of their ability to address ecological crises. Normatively, it finds expression in accounts of a green state (Eckersley 2004; Barry and Eckersley 2005) and a sustainable economy (Trainer 1996).

An ecological approach, certainly one grounded in social ecology (Bookchin 1980), brings with it a more critical view of the state, able to situate the state within broader social relations which tie it to industrialism and militarism in ways which are problematic from the point of view of sustainability. Appreciating the multidimensionality of the state is critical to understanding its imbrication in energy systems closely tied as they are to commercial, accumulation, geopolitical and military strategies (Johnstone and Newell 2018). This challenges the idea of the state as a neutral arbiter of competing energy pathways. Historically speaking, as Conca (2005: 181) notes: ‘The emergence of the centralising, industrialising, national state, with its capacity to centralise decision-making, concentrate capital, strip local communities of their historical property rights in nature, supply coercive power and protect elite interests, has been a key social innovation along the road to global planetary peril.’

Going beyond conventional political economy analysis, an ecological approach illustrates why industrialism, and not just capitalism, is problematic ecologically (Newell 2019). It also holds a distinct view of growth as problematic and unsustainable. In this sense, as Dobson (1990: 32) suggests: ‘It makes no appreciable difference who owns the means of production if the production process itself is based on the assumption that its development need not be hindered by thoughts of limits to growth.’ This challenges some critical accounts of transitions which assume that by changing ownership structures, or even more fundamentally the mode of production, more sustainable energy systems can be created. Green views cast doubt on that idea and would emphasise much more the need for supply-side constraints on production and radical reductions in demand, rather than just diversifying energy options. Such a perspective differs sharply from given assumptions in many literatures on innovation, environmental management and ecological modernisation, for example (Mol 2003), as well as dominant narratives about green growth (OECD 2011).

But it also raises questions about how, for what and by whom the economy should be organised. Applied to energy, it would prioritise sustainability over other traditional energy policy objectives and see it as a sub-set of the larger question of the viability of the system, since energy access and security do not amount to much in a context of runaway climate change. It would also ‘ecologise’ the study of...
energy transitions, not viewing them as isolated from, or disembodied from, other ecosystems and ecological cycles such as land, water and air. As we will see in each of the chapters, choices made in one domain imply change and impact upon all other ecological domains, even if siloed policymaking often makes it hard to comprehend, let alone act upon that reality (Royston et al. 2018). This raises issues of policy coherence and integration that I discuss in Chapter 5 on governing transitions and it comes through strongly in discussions of the nexus and linkages among the Sustainable Development Goals (SDGs) (Kuzemko et al. 2018). Methodologically, it is informed by ecological economics and an appreciation of ecological stocks and flows and patterns of uneven exchange which characterise contemporary global energy systems (Söderbaum 2000; Costanza 1991). Because of a strong normative commitment, bringing a (political) ecological perspective to energy transitions raises difficult questions about urgency and rapid change, which I will return to elsewhere in the book, while at the same time being sceptical about state-led and market-led transformations. It operates then as critique, normative vision, as well as contributing to strategic thinking (Newell 2019).

Overall, then, the approach here seeks to simultaneously politicise, historicise, globalise and ecologise energy transitions. The focus throughout the book is on power and politics as manifest in contests over producing transitions between labour, the state and different types of (fossil and other) capital; financing disruption and creative destruction; governing transitions involving the state and non-state as well as transnational actors and global governance institutions; and finally, but critically, mobilising and culturing transitions through resistance to energy extractivism and energy injustice and through building alternative pathways.