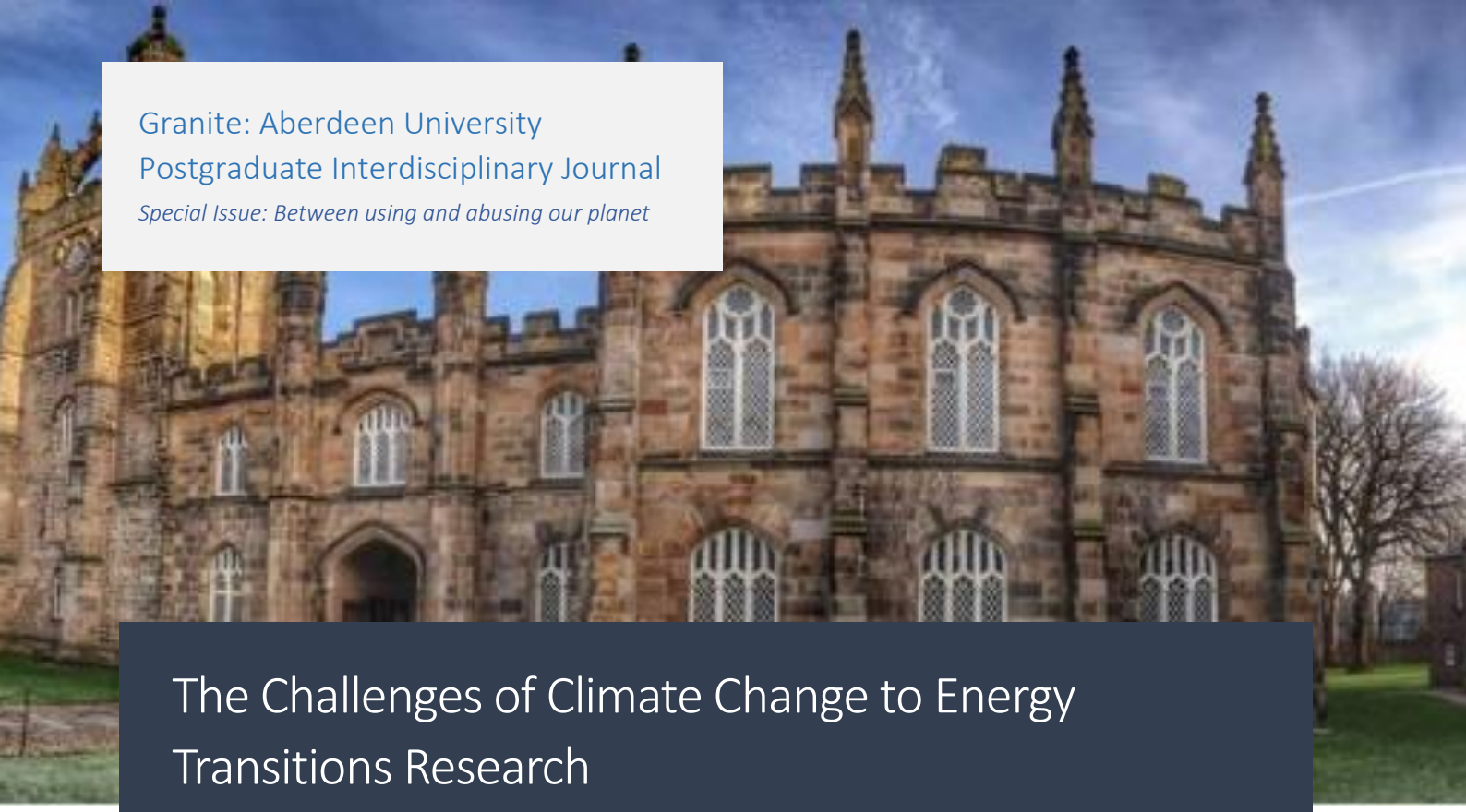

Granite: Aberdeen University Postgraduate Interdisciplinary Journal
Special Issue: Between using and abusing our planet

The Challenges of Climate Change to Energy Transitions Research

MSc Kathryn Wolfley, University of Aberdeen, Politics and International Relations

ABSTRACT

Societies are becoming increasingly aware of the current and potential future effects from climate change and how our use of energy contributes to greenhouse gas emissions. The world's energy systems are still predominantly based on fossil fuels, meaning that transitions to low-carbon energy systems present substantial challenges for societies and their governments. Much of energy transitions scholarship is based on economic theory and methodology. Uncovering the economic forces at play do not answer all lines of inquiry, however; the civil discourse and attitudes concerning incumbent energy sources, as well as their alternatives, should be better understood as to adequately inform government actors who must work to guide transitions to low carbon systems. Virtually all sources of energy are accompanied by controversy and trade-offs for society. This essay will discuss the current state of the research into the dynamics of energy transitions, as well as these challenges, by briefly examining the historical contexts for the existing, majority fossil fuels-based energy systems and how that factors into the issues that accompany decarbonisation.

Keywords: Energy transitions; climate change; energy balance; energy research; history of energy; decarbonisation

Granite
pp. 25- 30
ISSN 2059-3791

01 Introduction

02 Energy Transitions Research

03 Challenges to Energy Transitions Research production

04 Historical Contexts

05 Tackling Energy Transitions

Introduction

While remaining firmly rooted in the fossil fuels era may feel to some anachronistic, the extraction, trade, and use of dominant energy sources i.e. coal, oil, and natural gas is exceedingly complex and sophisticated. Vast sums of investment are embodied in the global infrastructures that facilitate carbon-based energy use, and this capital is difficult to write off and replace (Smil, 2016). However, fossil fuel combustion contributes to the increase in greenhouse gases in the atmosphere. While alternative forms of energy continue to advance technologically or demonstrate scalability and commercial viability, the global energy balance-as well as most states- is still overwhelmingly based in fossil fuels. Much attention is directed to oil and gas markets or household energy consumption, and many hang their hopes on greater inclusion of renewables, but change in energy systems, particularly on national levels, is an extremely long process. The so-called transitions from wood to coal, or coal to oil can be somewhat misleading, since none of these energy sources have been entirely eradicated from most national balances. The next transition, one to low-carbon systems and societies, perhaps also misleadingly implies that the shift will be complete. Certainly, finite sources entail an inevitable end to their use. However, not only are there sufficient supplies of oil and gas to last for decades at current and expected demand, our infrastructures and technology are not well suited for the level of integration of large-scale decarbonisation.

The effects and potential threats of climate change present societies with the astonishing task of mitigation and changes in infrastructure, economies, and individual behaviour. Research into energy systems past, current, and future strive to enhance understanding of how such systems develop and operate and how the low-carbon transition can be obtained with minimal disruption to societies. The imminence of climate change may serve as potent incentive for change, but the challenges are drastic. This essay discusses the implications of climate change on energy transitions research by briefly presenting the historical contexts of the current state of energy infrastructures and some, largely Western, government energy policies.

Energy Transitions Research

This research entails the study of how energy systems emerge, grow change, and decline. They involve any conversion of energy from any raw source and the associated end-use services for human use. The dimensions are myriad, involving technical, political, environmental, social, and temporal factors. Consequently, this requires a systemic approach in research and policy and must draw from a vast range of disciplines and industrial sectors. Virtually no energy source or technology is absent of controversy and ebbs and flows of public opinion and political favour; likewise, none is divorced from significant investments in capital. While past energy transitions could be characterized as being emergent, implying that there was little guidance or top-down intervention or influence in their development, the low-carbon transition requires considerable government direction and dramatic, potentially imposed, changes at the consumer levels. While consumers may demand cleaner sources of energy, some sectors, such as transportation, are limited in how quickly or how affordably they can adapt technology to meet that demand. A look at the history of energy use shows that transitions involve extremely long cycles in innovation, growth, and decline, and some scholars such as Grubler and Wilson (2011) only count two unfinished transitions in human history: first, explosion in the quantity of global energy use following the Industrial Revolution, and second, the accompanying improvements in the quality of energy delivered by energy infrastructures.

The introduction and changes of an energy source or service in a system follow a general pattern but are highly contextual upon the societies or economies in which they occur. The pattern consists of four steps: innovation, upscaling, peak, and decline (Grubler, 2012); these are the general technical/economic cycles. Empirical work (Fouquet, 2010; 2016) largely involve theories of supply and demand, particularly regarding the ease of ability for both consumers and producers to respond to changes in energy costs/prices. For economics-based transitions research, the drivers of change are, of course, economic but also include technology as a factor, since technological progress is highly associated with economic growth (Snowdown & Vane, 2006, p. 628) and changes in energy systems.

Some researchers adopt an approach in which technology/science and even the energy sources themselves are social constructs (Wiebe, Hughes, Pinch, & Douglas, 2012, p. 51). This approach emphasizes social factors and institutions which introduce, accept, reject, and modify technologies for human use. I argue that none of the approaches is individually sufficient to appreciate the challenges and scale of the questions posed in transitions research, and this is largely due to the complexity and competing interests of societies and energy systems.

Challenges to Energy Transitions Research

The link between energy systems and use and the threats of climate change is obvious, but very little is simple regarding the pressures of climate change mitigation and demands on behaviour and energy systems. In terms of research, the concerns of climate change and energy systems are approached largely within the scope of a specific discipline, such as economics, engineering, or environmental science, and its theories; I think vital factors may be omitted. The sheer scope and timeframe of necessary changes is daunting. Informing

policy entails a consideration of not only technical and environmental concerns, but also politically and socially sensitive interests, particularly in societies heavily dependent on imports or exports of energy resources.

Perhaps the best way to frame the issue and potential threats is by appealing to government and societal desires for continuity- essentially, energy security. Energy security can be conceived as a reduction of risk, namely human, technical and natural risk (Winzer, 2012). Climate change is a human-caused, meteorological event affecting human societies, which require energy systems to live and support economies. Governments wish to continue and for economic growth, or in the least for stability. Therefore, governments wish to ensure some level of energy security.

Unfortunately, even understanding the system from an energy security perspective is difficult, as different societies will identify various threats to their systems and economies. Governments are concerned with both energy security and (generally) climate change mitigation, though these aims often conflict. In some literatures (Winzer, 2012), the threats of climate change, current or future, are considered in the energy security context. In this framework, climate change poses a unique, sustained, permanent threat. The threat is unique in the sense that humanity has never tackled the issue before, and sustained in permanent in that it constitutes the need to alter the system beyond the consumer level and it will persist through time. In addition, many of the associated threats are unknown. Emissions are sourced from individual economies but the effects are global, i.e. externalized. Mitigation efforts are expensive and require cooperation and transparency between nations regarding emissions reduction targets and compliance.

Historical Contexts

Perhaps the most salient event in the realm of energy security, at least in the West, are the political crises in 1973 and 1979, when Iran placed an embargo on sales to certain Western states in retaliation for government support for Israel. Coupled with volatile price increases and uncertainty regarding politically unstable and unreliable producer states, the response to such crises was to develop domestic or alternative energy resources to limit dependence on imports from the Middle East (Parra, 2010, p. 249). By the 1970s, the Organization of the Petroleum Exporting Countries (OPEC), formed in 1960 of a band of producer states, had become increasingly critical of foreign firms and governments dictating, however clumsily, the oil price. Individually, OPEC members began to nationalize industry assets and operations, buying and forcing out Western firms from their territory. In response to these developments and the price shocks, importing states invested in domestic production, such as the North Sea oil and gas development, fleets of nuclear plants, and coal extraction (Parra, 2010, p. 247). While these investments did not necessarily result in energy independence, they did serve as powerful examples of how serious energy security is to energy-hungry societies and their governments.

Tackling Energy Transitions

Of course, the issue of energy security is not currently settled. The Middle East is hardly the unstable powder keg in terms of reliability of supply, and global reserves of oil and gas are not severely limited as thought in the 1970s, but societies are still generally sensitive to

threats of supply disruption. But now there is also the threat of adverse climate change impacts, and the state of progress is, on its face, grim. While renewable or low carbon, i.e. nuclear, energy sources comprise an increasing proportion of energy mixes, typically the shares are marginal or not commercial. Nuclear and coal power plants are of similar vintage, with many nearing or past their intended operating lifespan or encountering stricter or prohibitively expensive regulatory and economic environments. As stated earlier, energy projects are nearly universal in attracting public protest or controversy; even renewable projects are subject to oppositional demonstrations or petitions.

Both mature and emerging economies still largely demand energy intensive sources and services, particularly in the transportation sectors. Automobile-loving or dependent societies will find it especially difficult to implement structural changes in work and lifestyles to decrease carbon emission. Emerging economies are hardly likely to accept impositions on their need for intensive energy sources as they move through the industrializing process. Finally, there is a lack of definitive leadership and governance for low-carbon transitioning and climate change mitigation efforts. The 2015 Paris agreement for states to individually work to reduce emissions was dealt a blow when the United States withdrew in 2017. The coordination aspect of the agreement will be especially hard to enforce without transparency and without individual states meeting their own targets. Emerging economies are given some measure of exceptions due to their need for fossil fuels in industry.

These factors present a nontrivial challenge to all societies; research will be limited by existing technological constraints, funding, and pushback by legacy fossil fuels producers. Economies particularly sensitive to drawbacks in fossil fuels imports/exports will also be reluctant to implement sweeping change. Fighting climate change and supporting energy transitions research is undoubtedly extremely challenging, but there also exist many avenues for meeting the challenge. Demand for energy intensity tends to decrease at some point in the maturation of economic growth, so instead of reaching peak oil supply, we may instead encounter peak oil demand. If this cycle works together with concerted efforts to decarbonize our economies, there is hope that the greatest effects of climate change can be avoided.

References

Fouquet, R. (2010). The slow search for solutions: Lessons from historical energy transitions by sector and service. Energy Policy, 38, pp. 6586-6596.

Fouquet, R. (2016). Historical energy transitions: Speed, prices and system transformation. Energy Research & Social Science, 22, pp. 7-12.

Grubler, A. (2012). Energy transitions research: Insights and cautionary tales. Energy Policy, 50, pp. 8-16.

Parra, F. (2010). Oil Politics: A Modern History of Petroleum. London: I.B. Tauris & Co Ltd.

Smil, V. (2016). Examining energy transitions: A dozen insights based on performance. Energy Research & Social Science, 22, pp. 194-197.

Snowdown, B., & Vane, H. R. (2006). Modern Macroeconomics: Its Origins, Development, and Current State. Cheltenham: Edward Elgar Publishing Limited.

Wiebe, E. B., Hughes, P. H., Pinch, T. J., & Douglas, D. G. (2012). The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology. MIT Press.

Wilson, C., & Grubler, A. (2011). Lessons from the history of technological change for clean energy scenarios and policies. Natural Resources Forum, 35(3), pp. 165-184.

Winzer, C. (2012). Conceptualizing energy security. Energy Policy, 46, pp. 36-48.