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Introduction

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I recently read two books, one by a physicist, and one by an economist . . . How could these two smart people come to such different conclusions?[1]

OVERVIEW

A common complaint from policymakers and scientists is voiced when a policy is implemented but yields unexpected results. The argument asserts that the technology is sound and the policy is rational. Yet the policy is often met with unexpected public reactions based on 'irrational' responses. When energy policy is confronted with real-world social and institutional forces, the importance of multidisciplinary analysis becomes all the more important. As the late David MacKay put it in his quest to understand why substantive and effective energy policy is so elusive, 'We are inundated with a flood of crazy innumerate codswallop.'[2]

The approach of scientists and technologists to energy policy tends to be characterised by the promotion of preferred technologies with desirable theoretical properties, and an oft-stated exasperation at the speed at which political systems put in place policies to adopt such technologies. Thus scientists and technologists frequently promote particular combinations of nuclear power, renewables, carbon capture and storage and smart demand-side management to solve future energy problems. They justify their positions with reference to quantitative models of energy and climate systems. 'Good' energy policy is, for them, about getting the technology right. Considering the promise of reduced carbon emissions, economic growth and greater efficiency of industries, there is good reason for technology to play a role at the start of the policymaking process. But the start of that process is actually about society and what society wants. There are several excellent books, including those by authors from some of our technology and science colleagues at the University of Cambridge, such

[1] David J. C. MacKay, *Sustainable Energy – Without the Hot Air*, 1st edition (Cambridge: UIT Cambridge Ltd., 2008), 2.
[2] MacKay.

as David MacKay's *Sustainable Energy – Without the Hot Air* and Allwood and Cullen's *Sustainable Materials Without the Hot Air*, that exemplify a technology-focused approach.[3] Among academics, it appears that there is a hierarchy of disciplines as to how climate change is framed. As O'Neill et al. point out, 'an epistemological hierarchy exists in the framing of climate change whereby the geosciences disproportionately influence the representation of climate change as primarily an environmental issue'.[4] Government agencies also often follow this pattern. When doing a search for publications from their website, the first page of publications from the UK's Department for Business, Energy and Industrial Strategy (BEIS) provides a glimpse of what factors the department emphasises with 'energy' as the selected category. In the most recent list of publications ranging from 25 January to 12 February 2018, out of forty-one publications based on titles and abstracts, only three indirectly reference non-economic social constraints.[5] A cursory search of publications from the independent UK Committee on Climate Change and the Directorate General for Energy of the European Commission illustrates a similar-patterned focus on technology. Policy questions of implementation are often relegated to solely market mechanisms.[6] Even the work of the Intergovernmental Panel on Climate Change (IPCC) 'has been characterized as "unidisciplinary", as it is based on a clear separation between the natural sciences and social sciences, and an understanding that social sciences are based on natural sciences'.[7] These examples share an implicit assumption about policy goals, and thus limit the strength of their supporting arguments. Specifically, the limitation is that the policy goal is defined as 'reasonable' or 'rational' according to technical parameters, and any barrier to implementation is seen as a type of 'politics' that is by definition less 'reasonable' or 'rational'.

This pattern is, of course, part of a wider problem of considering social sciences and humanities under the umbrella of scientific advice. Although in the UK, science advice nominally includes the social sciences, the House of Commons Science and Technology Committee, which oversees government policy, expressed concern that the then-Chief Scientific Adviser's 'advocacy of social science has been lower profile than his contributions in areas of natural and physical science'.[8]

[3] Julian M. Allwood and Jonathan M. Cullen, *Sustainable Materials Without the Hot Air: Making Buildings, Vehicles and Products Efficiently and with Less New Material*, 2nd edition (Cambridge: UIT Cambridge Ltd., 2015); MacKay, Sustainable Energy – Without the Hot Air.

[4] Saffron J. O'Neill et al., 'Disciplines, Geography, and Gender in the Framing of Climate Change', Bulletin of the American Meteorological Society 91, no. 8 (16 March 2010): 997–1002.

[5] 'Publications – GOV.UK', accessed 13 February 2018, https://www.gov.uk/government/publications.

[6] 'Publications', *Committee on Climate Change* (blog), accessed 13 February 2018, www.theccc.org.uk/publications/.

[7] Eleftheria Vasileiadou, Gaston Heimeriks, and Arthur C. Petersen, 'Exploring the Impact of the IPCC Assessment Reports on Science', *Environmental Science & Policy* 14, no. 8 (1 December 2011): 1052–61, https://doi.org/10.1016/j.envsci.2011.07.002.

[8] 'Scientific Advice, Risk and Evidence Based Policy Making', House of Commons Science and Technology Committee, Seventh Report of Session 2005–06 (London: House of Commons, 26 October 2006), 15, https://publications.parliament.uk/pa/cm200506/cmselect/cmsctech/900/900-i.pdf.

As Cooper notes, 'Science advice is normally seen in the context of physical science advice.'[9] The House of Lords Science and Technology Committee even issued several reports calling for a Chief Social Scientist, but such a position was never adopted.[10]

Our book, on the other hand, is written as an antidote to a technocentric view of energy policy. As demonstrated by the cases comprising this book, we argue for a genuinely multidisciplinary approach – drawing on political science, economics, philosophy, theology, social anthropology, history, management studies and law inter alia – which takes social sciences and humanities thinking seriously in energy policy, thereby leading to a much richer set of insights into what makes for 'good' energy policy. Science and technology, and the type of quantification they champion, remain important, but they need to be combined with other disciplinary approaches. This is because many people are, quite rightly, not fully convinced by scientific arguments in the way that scientists assume they can be or should be. In fact, multidisciplinary approaches are better prepared to handle the complexity of the social policy environment in which policies are implemented. Purely technical approaches cannot account for the multilayered nature of social forces. Moreover, science is highly disputed, but scientists often oversimplify when it comes to policy. And this can undermine their own credibility by visibly dumbing down their arguments for a general audience. Instead, many of our authors would start from the premise that 'good' energy policy is much more multilayered, nuanced and non-obvious than it might appear, especially when we focus in on specific energy policy problems.

As is illustrated in the following chapters, what is clear is that policymaking is a complex and multidimensional process. The process of policymaking has been extensively studied by a large number of disciplines. It involves many different actors who often maintain irreconcilable goals and perspectives, and therefore a governance approach that listens to these groups and makes allowances for them becomes all the more important. Hence energy policy is not exclusively, or indeed, primarily, about energy, it is as much about policy itself.

As starting points for developing a multidisciplinary approach to 'good' energy policy, we draw on the cumulative lessons learned from a three-year-long seminar series titled 'In Search of "Good" Energy Policy', hosted at the Centre for Research in the Arts, Social Sciences and Humanities (CRASSH) at the University of Cambridge. The 2015–2016 series, where many of the following chapters were first presented, brought together some twenty academics from a dozen departments in the University of Cambridge, as well as academics and practitioners from around the

[9] Adam CG Cooper, 'Exploring the Scope of Science Advice: Social Sciences in the UK Government', Palgrave Communications 2 (5 July 2016): 16044.

[10] 'The Role and Functions of Departmental Chief Scientific Advisers – Science and Technology Committee', Science and Technology Committee (House of Lords, 14 February 2012), https://publications.parliament.uk/pa/ld201012/ldselect/ldsctech/264/26402.htm.

world, to approach energy policy from a multidisciplinary perspective. What became clear, early on, from our discussions is that the quest for 'good' energy policy requires a deep understanding of local, regional and national preconditions, of history and of social, political and cultural institutions, indeed the very understanding exhibited in the chapters of this book.

A number of lessons stood out. First, if it is to be at all manageable even in a multidisciplinary project, the term 'good' needs to be defined in the context of policy. Second, starting points matter, and legacy investments by companies and consumers cannot be lightly written off in favour of new technologies. Starting points immediately suggest the importance of timing and place, in other words context, for what makes for 'good' policy. Third, 'bad' policies can and do persist for decades after both their problems and their solutions have been identified. Fourth, predictions about the future have a poor track record, but asserting claims about the future lie at the centre of a technology-based approach. And finally, 'good' policy processes involve consultation and the taking into account of various interests and views; this necessarily gives rise to the modification of original plans. These starting points are common to many disciplines, and they offer an antidote to the assumption that there are technologically 'obvious' answers in energy policy.

This is not to say that there are no clear answers in the study of energy policy or that there is no basis for ranking alternatives according to defined sets of criteria. Neither the editors, nor any of the contributing authors of this book, set out to argue that. For example, some policies will very clearly raise the level of energy security by diversifying energy supply sources. Others will clearly contribute to social welfare by targeting support to vulnerable segments of society, the recent discussion about energy poverty in the UK being a case in point.[11] Other examples in the cases comprising the bulk of this book will focus more on the environment. The UK's momentous Clean Air Act or Germany's Energy Transformation (*Energiewende*) are cases in point. In these examples, society sets a goal and the policy may be evaluated by how clearly and effectively it contributes to meeting the goal.

1.1 WHY DO WE NEED A MULTIDISCIPLINARY SOCIAL SCIENCE– AND HUMANITIES–BASED APPROACH TO ENERGY POLICY?

As we have suggested, there is a tendency for debates about energy policy to start with the science and technology (with generic statements such as 'because of climate science we need more nuclear/solar/wind energy') and then proceed to policy

[11] 'Energy Prices, Profits and Poverty', House of Commons Energy and Climate Change Committee (UK Parliament), accessed 13 February 2018, www.parliament.uk/business/committees/committees-a-z/commons-select/energy-and-climate-change-committee/inquiries/parliament-2010/energy-prices-profits-and-poverty.

solutions, with far less attention to the social and political aspects of policy implementation. In the words of one foundational IPCC report:

> The effectiveness of measures to mitigate or adapt to climate change depends to a great extent on technological innovation and the diffusion of technologies. The transfer and/or diffusion of [technologies] across and within countries is now considered a major element of global strategies to achieve climate stabilization and support sustainable development.[12]

One renowned technologist who did recognise the role of social constraints and who began this project with us before his untimely death was David MacKay, our colleague at the University of Cambridge in the Department of Engineering. MacKay was not only a talented physicist, he drew from his experiences of practical policymaking from his time as a civil servant in the Department of Energy and Climate Change (DECC), since 2016 part of the Department for Business, Energy and Industrial Strategy (BEIS). Energy policy is fundamentally about policymaking. Thus, one would think that law, politics, economics and history are actually the obvious places to start rather than beginning with questions of technology. Nonetheless, we do not challenge the ordering of the traditional policymaking process, beginning with science and technology as the starting point. Nor do we advocate that moving immediately to formulating policy options is the problem. Rather, what becomes clear in the analysis of real-world cases in this book is the need to insert other disciplinary perspectives early on into the policy formulation stage before moving too hastily without taking these perspectives into consideration. There will, of course, be cases where urgency precludes time to pause for reflection, but in general, most of the problems raised by the cases in this book, not to mention the most common energy policy goals of modern societies, represent multiyear and even multidecade processes. Without stating the obvious, the consequences of reckless policy making are dire, economically and politically. Some important examples over the past half-century range from energy's role in the access to Middle East supplies, the oil embargo resulting from the Yom Kippur War to, more recently, the stand-off between Ukraine and Russia over natural gas, which played a central role in the Ukraine Crisis.[13] Energy policy is important because of the economic significance of energy within individual economies and in international relations. Expenditures on energy can be around 10 per cent of GDP, in the UK for example, and are subject to significant volatility due to changes in

[12] 'Working Group 3 Third Assessment Report (TAR)', Intergovernmental Panel on Climate Change (IPCC), accessed 6 March 2018, www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=421.

[13] Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power* (New York: Simon & Schuster, 1991); Michael L. Ross, 'How the 1973 Oil Embargo Saved the Planet', Foreign Affairs, 15 October 2013, www.foreignaffairs.com/articles/north-america/2013-10-15/how-1973-oil-embargo-saved-planet; Chi Kong Chyong, 'The Role of Natural Gas in Ukraine's Economy and Politics' (26 May 2014), http://www.eprg.group.cam.ac.uk/wp-content/uploads/2015/02/Chyong_presentation-EE-26-May-2014.pdf.

international commodity prices. For energy-exporting countries, energy can be a significant share of GDP, tax revenue and exports, making these countries particularly vulnerable to the state of the global energy market.

One would think that the sheer ubiquity of energy policies would lead to the emergence of a clear and shared understanding of what makes for 'good' energy policy. However, that is not the case. Countries (and indeed regions within them) differ sharply on their approach to energy as evidenced by different levels of tolerance for energy insecurity, wildly differing final energy prices and different attitudes to the environmental aspects of energy production and use. And this is not unique to energy policy. The same can be said for other policy areas such as education and healthcare.

In almost every country, energy policy is politically controversial and the subject of vigorous debate. In fact, many of the cases in this book point to the fact that this is a 'normal' state of affairs in democratic societies these days. This is because energy takes different forms and policy needs to address energy use in electricity, heating and transport and to reconcile the interests of households, commercial businesses and industry. Policies that are good for one sector or group of users may not work so well for others. Energy-intensive industry, such as steel producers, driven by their exposure to international trade, may simply want the cheapest possible energy and may be unwilling to support policies aiming to clean up the environmental aspects of energy production. Households may express contradictory views on energy, simultaneously wanting cleaner energy, while not being willing to pay more for it or to have renewable sources of energy – such as wind turbines – located near to their property. This represents a tension between behaviour as a citizen-voter and likewise as an energy consumer or producer.[14] At the heart of these contradictions is the idea that there is a trade-off between what are widely regarded as the three central objectives of energy policy, namely reliability of supply, low energy prices and the environmental impact: security, affordability, sustainability. This assumes that improving the outcomes of two of the energy policy goals can only be done at the expense of the third. Therein lies the contentious area of government policy, which is often described as requiring the reconciliation of affordable, clean and secure provision of electricity, heating and transport fuel.[15] Unpacking each term of the 'energy trilemma' can be fraught: promoting energy investment may be in tension with lower residential prices; reducing greenhouse gas emissions does not necessarily imply lower local and regional adverse impacts; and more reliable supplies may not necessarily be indigenous supplies.[16]

[14] Elcin Akcura et al., 'From Citizen to Consumer: Energy Policy and Public Attitudes in the UK', in *The Future of Electricity Demand: Customers, Citizens and Loads*, ed. Tooraj Jamasb and Michael G. Pollitt (Cambridge: Cambridge University Press, 2011), 231–48.

[15] Michael Pollitt, 'In Search of "Good" Energy Policy: The Social Limits to Technological Solutions to Energy and Climate Problems', Working Paper Series (Energy Policy Research Group, November 2015).

[16] 'The Energy "Trilemma": How Did We Get Here? | The Big Energy Debate | The Guardian', accessed 18 April 2016, www.theguardian.com/big-energy-debate/energy-trilemma-how-did-we-get-here.

Many developing countries appear to have disastrous energy policies that manage to worsen energy security, result in high delivered prices and are associated with high negative environmental impact. The willingness of developing countries, such as Malaysia, China or the UK of the past, to tolerate such a mix of policies can be difficult to comprehend in developed countries. Remarkably, countries that have objectively worse energy policies from a social welfare and environmental perspective can be perceived internally to have good energy policies. According to a recent Edelman global survey, the publics of China and Russia have a much higher degree of trust in their governments concerning the energy sector than businesses.[17] The comparison of measurements for China is 76 per cent trust in government versus 67 per cent for businesses. In Russia, the level of trust is lower than China but still higher for the government at 44 per cent compared to 39 per cent for businesses. The reverse is true in the UK and US (and other liberal democracies such as Canada, France and Australia) with a higher degree of the public's trust placed in businesses compared to government. This occurs in the energy sector because bad policymaking is not unique to energy *and* because of different valuations of some aspects of energy supply. Thus energy consumers in developing countries may be more willing to tolerate poor air quality (or less willing and able to pay the costs of cleaning it up) or they may be more willing to get some energy very cheaply, even though underpayment directly leads to very poor continuity of supply. Historians have recently pointed out that in phases of rapid economic development it may be that improving environmental quality may be seen to conflict with energy comfort whether it be cooking demand in Rome 2,000 years ago or mining silver in Peru during the sixteenth century.[18]

In developed countries, energy policy is not so obviously problematic as supplies are often reliable and the local environmental impact is much less, partly because prices are significantly higher and there is more commitment to the adequate financing of companies involved in energy supply. Instead what we often observe are a large number of individual energy policies, many of which may appear to be sensible on their own, but which in aggregate result in a 'mess' of policies, in the spirit of Rhodes.[19]

1.2 MULTIDISCIPLINARY APPROACHES TO ENERGY POLICY

We would expect the contents of this book to appeal to a broad audience owing to its multidisciplinary theme and relevance to both current events and historical

[17] Edelman, '2016 Edelman Trust Barometer – Energy Results', 12:59:29 UTC, www.slideshare.net/EdelmanInsights/2016-edelman-trust-barometer-energy-results?ref=http://www.edelman.com/insights/intellectual-property/2016-edelman-trust-barometer/turbulent-times-call-for-new-strategies-in-building-trust/.

[18] Jim Morrison, 'Air Pollution Goes Back Way Further Than You Think', Smithsonian, 2016, www.smithsonianmag.com/science-nature/air-pollution-goes-back-way-further-you-think-180957716/.

[19] See Lave (1984), who notes the tendency in the United States (and everywhere else) to regulate one externality at a time, rather than jointly optimise regulations.

developments in energy policy studies. The disciplines highlighted in this book aim for a balanced representation and include, in no particular order of emphasis, economics, politics, law, history, anthropology, management and policy studies, theology and philosophy. We recognise we are not being fully comprehensive, as space and time have limited our inclusion of other relevant disciplines such as behavioural science and psychology. Likewise, considering its energy and policy focus, this book would also be useful for all stakeholder groups involved in energy policy including industry, policymakers and technologists.

Moreover, the book follows in a line of previous studies that incorporate different disciplines in the analysis of policy, making a contribution in the specific field of energy policy studies. Our emphasis on multidisciplinary approaches, one that draws from several social science disciplines, puts us in the company of a rather small group of academic centres of energy policy. Other examples of multidisciplinary research groups where energy policy plays a leading role include the Steyer-Taylor Center for Energy Policy and Finance at Stanford University, the Energy Research Group at the University of California at Berkeley, the Sussex Energy Group within the Science Policy Research Unit at the University of Sussex and the Department of Engineering and Public Policy at Carnegie Mellon University, not to mention an entire faculty of Technology, Policy and Management at TU Delft. Between universities, a notable interdisciplinary project is SHAPE Energy, an EU-funded, Horizon 2020 platform. More recently, all of these groups have advanced the policy debate through multidisciplinary research and are to be commended as the pioneers in this field. With respect to energy and resource policy think tanks, a recent ranking of the top ten shows that the overwhelming majority are monodisciplinary and primarily economics based.[20] Although there may be several academic groups that focus on multidisciplinary energy policy-related activities, books that draw on the multidisciplinary collaborative experience are still lacking.

In this research environment, it is not surprising that there has yet to be a single volume that synthesises multidisciplinary work on energy policy in the way presented in this book. No work has yet appeared that ties together the multidisciplinary efforts of a full series of cases and geographic contexts. This book is also unique insofar as it is explicit about disciplinary perspectives rather than attempting to seamlessly integrate them. While we present case studies from different individual disciplines in the second part, the third part attempts to go further by offering examples of cases where several disciplines have collaborated in the quest for genuine multidisciplinarity.

Not surprisingly, much of the scholarship on energy policy research is presented from the perspective of one discipline. When academics have examined energy policy through multiple disciplines, they have typically focused on one dimension,

[20] 'TTCSP Global Go To Think Tank Index Reports | Think Tanks and Civil Societies Program (TTCSP) | University of Pennsylvania', accessed 7 March 2018, https://repository.upenn.edu/think_tanks/.

such as nuclear energy or renewables. Scholars from the social sciences have sometimes collaborated to produce multidisciplinary books, but these tend to be geographically specific, such as EU energy policy, energy policy in the United States or energy policy in China.[21] While the merits of drawing from multiple disciplines to address a single geographic region is a step forward, a multidisciplinary book with a global view that addresses the complexities of the whole energy system, including normative questions of fairness and justice, was still lacking.

1.3 EXAMPLES OF DIFFERENT DISCIPLINARY APPROACHES IN SOCIAL SCIENCES AND HUMANITIES

The simultaneous reconciliation of multiple competing objectives in energy policy is not new, in our culture or our history. The Jesus of the Bible, speaking two millennia ago, even told a story in which ten young women faced a trade-off between energy security and cost![22]

Our aim here is to identify the areas in which the social sciences and humanities may contribute to our understanding of 'good' energy policies, and to build a framework for future multidisciplinary approaches. 'Good' energy policy attempts to simultaneously deliver on the multiple objectives of energy policy – which, inter alia, include clean, secure and affordable energy – with minimal negative social consequences. By way of illustration, we will highlight the potential contributions that the disciplines of political science, economics, philosophy, theology, history, social anthropology and law offer to the study of energy and climate policies.

Political science can analyse the opinions of members of society, key stakeholders and the limitations of political processes to deliver change. Economics can help frame the incentive design aspects of institutions and what markets and incentive regulation might be able to deliver if appropriately calibrated to the particular situation at hand. Philosophy explores fundamental questions about the ethics of energy production and end use in addition to normative obligations (and aspirations) of current generations to future generations including the fairness of distribution along existing consumption patterns. Theology raises wider issues about humanity's relationship to and responsibility for nature. It poses questions about the cultural and moral driving forces that may be sustaining environmentally and socially damaging energy practices, as well as what role religious leaders may have to play in promoting sustainable living and the role of community versus state in both

[21] Energy policy books examining geographic regions are vast. A few notable and recent examples of these regions include: P. Andrews-Speed, *The Governance of Energy in China: Transition to a Low-Carbon Economy* (Basingstoke, UK: Palgrave Macmillan UK, 2012); Peter Z. Grossman, *US Energy Policy and the Pursuit of Failure* (Cambridge: Cambridge University Press, 2013); Jale Tosun, Sophie Biesenbender, and Kai Schulze, eds., *Energy Policy Making in the EU: Building the Agenda* (London: Springer-Verlag, 2015).

[22] Hendrickson Publishers, *The Holy Bible: King James Version*, Gospel of Matthew, 25: 1–13 (Peabody, MA: Hendrickson Publishers, 2004).

secular and religious communities. Social anthropology pays attention to the cultural understanding of communities towards energy production and locally specific end use, which may limit or facilitate energy transitions. History has much to teach about the successes and failures of past policies, in particular how policies that we now think of as very successful often required several decades to have their full effect. Management and business studies, much like economics, is a common discipline in the study of energy policy, but it is also inherently a 'bridging discipline' with subfields spanning a range of social sciences.[23] Law may assist with the governance context, shedding light on how formal rule changes may or may not contribute to society's goals in local, national and international contexts. Meanwhile the physics and engineering of the energy system remain important. Therefore, they will continue to set the technical constraints, and likewise, starting points for sensible policy.

It is also important to note that because social constraints are geographically and culturally contextual, regional studies scholars, by virtue of their inherent interdisciplinary nature, may be ideally suited for energy policy analysis. The disciplinary list is certainly not exhaustive, and the next part's chapters will further develop the preceding points on disciplinary contributions to energy policy discussions.

1.4 BOOK STRUCTURE

This book explores a number of research themes that are common to a significant number of disciplines in social sciences and humanities. These include:

1. the differing perceptions of problems being addressed by policy
2. the role of quantification and the use of quantification in establishing a scientific argument
3. the basis of well-being assessments for those affected by energy policies
4. how to build public trust in policies, and to respond to public concerns
5. the complementary roles of the state, different layers of government and nonstate actors
6. the competence of the parties involved and the role of hubris in delivery
7. parallels between energy policy and other policy areas, such as healthcare

What emerges is a not a set of answers but at least a set of questions and possible ways forward much more nuanced and sophisticated than might initially be thought possible within a singular disciplinary line of inquiry, drawing widely on experiences of policymaking across energy technologies, other sectors and jurisdictions around the world. From multiple perspectives, the following parts will also explore the central question of establishing what might be considered a 'good' energy policy. Does 'good' necessarily imply 'desirable outcomes' where ends are more important

[23] Dawn Youngblood, 'Multidisciplinarity, Interdisciplinarity, and Bridging Disciplines: A Matter of Process', Journal of Research Practice 3, no. 2 (5 December 2007): 18.