

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 "undisciplinary", 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/ldscitech/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 multidisciplinary.

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 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.

than means? Or is the proper conception of 'good' one of 'fairness' as assessed by philosophers, 'conducive to human flourishing' as assessed by theologians, 'efficient' as assessed by economists, 'better environmental outcomes' as assessed by scientists, even if these neglect other dimensions? Perhaps 'good' suggests rather a reframing of the 'trilemma' by calling for a balanced integration of economic, social and environmental objectives. And in practical terms, what if an analyst thinks one policy is better while the public broadly supports another policy because it is outwardly more salient? The book also clearly illustrates that a further obstacle to defining what a 'good' policy may be is the fact that academic disciplines, and even subdisciplines, will differ sharply over what is meant by a 'good' policy.

The book is organised around a set of case studies in energy policy, drawing on the cumulative experience of a large number of writers. The first part lays the groundwork for the case studies by offering a number of disciplinary perspectives on energy policy. The second provides examples of diverse disciplinary perspectives illustrated in several case studies. For each of the chapters, the authors describe what makes the case interesting from their disciplinary perspective. Each of the case chapters also includes a short response from another specific disciplinary perspective. Comments from the respondents are aimed at identifying bridging concepts and points that both disciplines, in the context of the specific case, have in common. We have attempted to include a balance of respondents that represent the disciplines included in this book. For example, the first case study on the ethics of nuclear power presented from a philosophical perspective, by Sabine Roeser and Behnam Taebi, receives a response from an economist, Sandy Skelton.

Next, the third part of the book takes the disciplinary bridging to the next level by expanding into multidisciplinary inquiry. These two cases, which examine clean air policies and Eurasian pipelines respectively, incorporate at least three social science disciplines in the design and analysis of specific policies. They are intended to demonstrate in a practical way different approaches to multidisciplinary analysis. The editors introduce the part with a chapter that overviews the current scientific thinking of multidisciplinary research.

In the final part, we include some short commentaries from authors who offer technological and industrial perspectives on energy policymaking. We respond to their comments by highlighting what some of our earlier chapters say about their suggestions. This final engagement sets the tone for measuring the efficacy and practical application of multidisciplinary studies, such as those included in this book.

The editors continued revising this book up to August, 2018.

1.5 HIGHLIGHTS AND KEY LESSONS

One might expect that a starting point for studying energy policy would be political science itself. Accordingly, this is where Part II begins. David Reiner in Chapter 2 shows, however, that energy has not become the theme of a distinct subfield of the

discipline of political science. Rather, energy has featured as a factor in investigations of both domestic politics and geopolitics, often in relation to shocks such as the 1970s oil crisis. More broadly, Reiner sets out how political scientists tend to work out of distinct philosophical frameworks through which problems are viewed, the most significant of which are ‘realists’ who focus on states as self-interested rational actors, and ‘liberals’ who grant more importance to nonstate actors and other institutions. By contrast, constructivists stress identity and the wider social determinants of actions, while Marxists argue for the centrality of the link between political actions and relations of production. These framings can lead to very divergent outcomes; what they share in common is the expectation of a philosophical frame.

Over time, debates about energy have become more integrated into the field of environmental politics, a process that has accelerated since the Rio summit of 1992 and the emergence of climate change as a leading international issue. This has put a transition away from fossil fuels at the heart of the political agenda, and in turn shaped work in political science. Arguably, the field has thus hitherto been rather reactive to events, and the positions adopted by political theorists often reflect entrenched philosophical dispositions.

In Chapter 3, the economist David Newbery addresses the implications of supposed market failure for good energy policy. He challenges the popular assertion that economists are market fundamentalists, that their goal is to get governments out of markets, and that they are indifferent to the social and distributional impacts of markets. Economic theory has demonstrated the specific conditions under which markets produce competitive efficiency. Economic theory has equally demonstrated that where such conditions for competitive efficiency are not present, government intervention is necessary. Intervention in markets is appropriate where there is indeed market failure. Such intervention may not be best placed to address problems of distributional justice (such as poverty). That should be, and often is, the task of public finance and public policy, such as through targeted public expenditure (on health, for example) or regulation of natural monopolies. Here goals such as fairness and equity properly apply and are balanced against efficiency considerations.

The chapter illustrates these features of markets in relation to energy policy. The limitations of markets, such as failure to supply non-excludable public goods like energy security or not pricing ‘externalities’ or environmental quality, justify government intervention through both market correction and regulation. Climate change mitigation is cited as a central example of how governments can correct for market failure through carbon pricing.

In Chapter 4, Tim Lewens provides a philosopher’s perspective on energy policy, distinguishing between good outcomes and good processes. He argues that it is in considering the latter that philosophy may offer a greater contribution. In terms of good outcomes, the key dimensions he examines are: (i) energy justice, which explores concepts such as equal treatment and the trade-offs resulting from differential impacts on affected groups; (ii) future generations, since those making energy

policy decisions will struggle to take account of those not yet alive; (iii) ‘non-identity’, since current decisions can also affect which future people will actually exist, completely changing the way we can interpret harm; and (iv) as the final challenge, the dizzying array of dimensions along which energy policies might be assessed including emissions, biodiversity, food availability and ways of life, particularly when there may be positive impacts along some dimensions, and negative impacts along others.

The chapter then turns to ‘good processes’, since philosophers have argued that ‘answers to complex questions like these are those that derive from good processes of deliberation’. One process consideration is the proper balance to be struck between technical elites and politicians who will be influenced by the public and other stakeholders. Any expert judgment will inevitably be value laden, so the question then is how to move beyond simple yes/no answers and find ways of introducing probabilities and uncertainties into the decision-making process. More generally, participation requires both disciplinary and ideological diversity among policy advisors as well as finding ways to incorporate the relevant knowledge possessed by laypeople. Finally, Lewens argues that precaution requires tolerating ‘significant uncertainties while making decisions about risk reduction’ and, as such, there is a need for a precautionary approach to govern how society regulates risks, rather than seeking out some all-encompassing simplifying ‘principle’.

In Chapter 5, Jonathan Chaplin describes how public theology would seek a ‘grounded’ energy policy rooted in a clear understanding of what makes for a ‘good’ or ‘virtuous’ human life, which includes both our relations with the non-human world and the wider pursuit of a ‘good’ society. Drawing on the statements issued by the major religions in the run-up to the Paris Accord in December 2015, Chaplin identifies five stances that are broadly convergent across the different religions and supported by public theology more broadly: (i) nature as a “‘divine” ordering of a universe marked by integration, equilibrium, balance and harmony’ rather than as infinitely exploitable; (ii) a call for human ‘stewardship’ or ‘trusteeship’ of nature; (iii) a shared acceptance of climate science and an urgent need to shift away from fossil fuels; (iv) questioning the potential for unlimited economic growth and finally, (v) situating energy and environmental questions within a broader commitment to a just social order.

According to many public theologians, not only is consumerism damaging our environment, economy and politics, but it is also ‘a debilitating spiritual and moral poverty which further enfeebles the human capacity to make the behavioural changes needed to combat environmental problems generally’. This perspective leads to critiques of the concentrations of power including large corporations in the energy sector as well as scepticism on the wider impact of carbon markets. Public theology seeks to introduce concepts of social justice and challenge definitions of economic growth or consumerism, which might prevent a deeper flourishing of both humans and the environment, while recognising at the same time the wider

context and need for 'historical patience' in seeking out solutions to the problems identified.

Then in Chapter 6, Charlotte Johnson opens up the realm of possible examinations of energy policy by explaining how approaches used in anthropology have the potential to explore new aspects of energy policy and to do so in new ways. She gives an overview of the burgeoning field of the study of energy in anthropology, or 'energopolitics' as it is sometimes called in anthropological studies. She points out that the exploration of energy policy 'offers fertile ground for anthropological investigation, impacting on some of the discipline's core theoretical concerns: power, value, identity, symbolism and myth'. Johnson then situates energy policy within four developed debates in which anthropologists are engaged, including: anthropology of the state, economic anthropology, material culture of the home and consumption, and digital and design anthropology.

Johnson then explains the approaches that anthropologists have used to explore energy policy including traditional ethnography, multi-sited ethnography that may follow infrastructure from place to place such as pipelines, and new approaches such as sensory ethnography and design anthropology, which transitions the anthropologist from 'observer into a position of active interventions' in experimental research designs. With respect to traditional ethnography, 'An anthropological approach suits the study of energy policy because it can examine in detail ways that people's livelihoods, their lifestyles, their sense of self and their ethics can be impacted or directly targeted by energy policy'.

Paul Warde offers a challenging perspective on what historians bring to the study of energy policy in Chapter 7. He distinguishes between history in the sense of the use of historical information to inform current policy and History – with a capital H – in the sense of the study of historical phenomena by Historians. Historians, according to Warde, bring a particular set of perspectives and methodologies – such as archival research – to the study of the past, which can help with the study of current policy. Indeed, he is critical of history – with a small h – which is often built on doubtful historical data. However, as he points out, historians are not primarily concerned about current policy and the assumption that anything can be learned from the past for current policy is not to be taken for granted.

However, historians do bring important perspectives to the study of the past: these include the idea that the success or failure of past policies are likely to be complex – though not necessarily complicated – and will likely involve the interaction of many different factors playing out on different timescales. Warde uses the history of failed energy predictions to illustrate what he means by the perspective of historians. Thus what historians might want to know about past predictions is not primarily why the predictions were wrong, but what process led to them being framed in the way they were, what determined how they were used in past policymaking and why voices that were subsequently shown to be correctly predicting the future were suppressed at the time.

In Chapter 8, Jim Platts, an engineer with many years of project management experience in the wind industry, offers a fascinating perspective on the management of large energy engineering projects. Such projects often go wrong and end up being delivered late and over budget. Using an example from Hong Kong, he points out that many large engineering projects are unique one-off feats of management, which rely on the successful collaboration of a large number of specialists and highly skilled individuals. When things start to go wrong it is very easy for projects to descend into a blame game, where no one individual, company or group takes responsibility for the project's failure to be delivered on time. Good management is required to lead such a complex team.

Platts goes on to point out that management is not just about 'giving orders' but about collaboration and listening. He proceeds to apply this principle of good management to the global wind industry, which has developed incredibly since its humble beginnings in the early 1980s. He points out that the culture of sharing learning, between engineers, and the long-term commitment of companies and individuals within the industry to building something that will last has been key to its success. This has led to sustained innovation which has enabled the scaling up of individual turbines and overall production and resulted in massive increases in installed capacity and falling unit costs.

In the final chapter of the first part, Chapter 9, Tibisay Morgandi and Jorge Viñuales show why, since 'law is the language through which energy policies are formulated and enacted', an assessment of a transition towards 'good' energy policy must reckon with both the capacities and limitations of 'legal form'. They note that the basic design of an energy policy already involves a range of legally complex choices. Carbon pricing, for example, could be pursued variously via: a tax; an emissions trading system; a regulation imposing a ceiling on certain types of emissions or the use of certain technologies promoted through a wider set of policies such as removing fossil fuel subsidies; setting renewable energy targets or supporting renewable energy. But there are further choices to be made in determining the precise legal form of such a policy: a tax law will differ according to what is taxed, how it is taxed and why it is taxed; it must rest on a proper legal basis, which in turn depends on questions of devolution of powers and proper implementation; and it must be consistent with broader legal norms. Such complexity is, however, frequently bypassed in technological and economic approaches.

The complexity of legal form is illustrated through three case studies. The extraction of shale gas in the European Union shows the importance of the question of whether an EU recommendation would be more successful if it were binding or nonbinding. The challenges of pursuing low-carbon policies in the United States demonstrate that highly specific choices of legal wording bear substantial consequences for the political options pursued at both domestic and international levels. The Indian government's policy of supporting the production of renewable energy equipment by imposing local content requirements (LCRs) shows

that, even though such a policy is vulnerable to long-term legal challenge by virtue of its breaching WTO trade rules, it may turn out to achieve short-term success in supporting indigenous producers. They conclude that energy policies are more likely to overcome political constraints and to be effective in securing stakeholder buy-in if they are expressed in a legal form that is 'adaptive to existing political conditions' and 'resilient to future legal challenges or amendments'.

After a review of how the different disciplines interpret 'good energy policy', Part II then presents a number of specific case studies that are developed by scholars from the different disciplines across a range of topics within the broad domain of energy policy.

In Chapter 10 on the ethics of nuclear energy, philosophers Behnam Taebi and Sabine Roeser show that while the Fukushima-Daiichi nuclear disaster led to major changes in nuclear energy policy in Japan and some European states, the demand for nuclear power facilities will continue to grow over the next decades given rapidly rising global demands for electricity, especially in Asia. Problems of nuclear waste disposal and of nuclear energy governance will continue to pose difficult challenges. The ethics of nuclear energy, then, will demand attention for a long time to come. Against the background of ethical debates about nuclear arms proliferation, the chapter begins by reviewing the course of debates about the ethics of nuclear safety (unintentional harm) and security (intentional harm) since the 1970s, noting that substantial technological advances in safety do not remove all risk or pre-empt difficult ethical choices where not all desirable criteria – affordability, fuel efficiency, minimisation of waste, reduced possibility of nuclear proliferation – can be simultaneously met.

Questions of intergenerational justice arise both because uranium is non-renewable while only current generations benefit from it and because the problem of waste will last for decades, forcing difficult and costly choices between 'open' and 'closed' fuel cycles. Management of waste from decommissioned, existing and new nuclear facilities, where multinational cooperation is increasingly favoured for security reasons, also creates major risks of both intra- and inter-generational injustice and of international injustice. Nuclear energy and waste in turn create the need for new and better instruments of global governance which, however, must work to overcome a continuing jealous defence of national sovereignty. The power of intense public emotions in the face of the risks of nuclear power will continue to present ongoing political challenges. Yet both 'technocratic' and 'populist' responses to such emotions fall short by assuming only quantitative measures of risk are relevant while they are inevitably value laden, ducking the ethical issues at stake and wrongly assuming that such 'irrational' emotions can shed no light on ethical dilemmas such as such as justice, fairness and autonomy. These considerations do not suggest a rejection of nuclear energy but rather that, to achieve better nuclear energy decision making, ethical reflection must be central to the process.

Next in Chapter 11, Christian Growitsch and Felix Höffler, both economists, provide an explanation for what really happened to the direction of Germany's

national energy transition policy, or *Energiewende*. By examining relevant data over a decade and a half, they show that the impact of Fukushima on German energy policy was minimal. The most important change was a slight acceleration to the phasing out of nuclear energy by the decommissioning of older plants. However, this was a process that had already begun in 2005. They also give a historical context to the *Energiewende* which explains, for those new to the subject, why the German public has long been uneasy with nuclear power relative to its neighbours, which is what makes Germany unique in Europe from an energy policy perspective.

Despite the media hype within Germany about the policy changes in response to Fukushima, as Chancellor Merkel explained to the Bundestag parliament, the *Energiewende* was already well underway with its policy roots formed nearly a decade before the Fukushima disaster of 2011. The authors also offer an insightful, almost anthropological explanation of social tendencies in Germany. They propose that, as an export-driven manufacturing economy, German society is predisposed to accepting technological solutions to wide-scale challenges such as climate change. Therefore, any policy that can demonstrate a new or transformative type of technology will be advantaged in its implementation.

The historical background to the adoption of high-carbon taxes in Sweden, as described in Chapter 12, by the historian Magnus Lindmark, is the tale of a first mover. Sweden has currently the highest effective carbon price – averaged price across all GHG emissions – in the world. Lindmark discusses the imposition of carbon taxes at around this level in 1991, significantly ahead of the EU ETS (2005) and almost every other country, save a handful of near neighbours.

The chapter makes three important points about Sweden's leading role. First, Sweden's starting point was extreme. It was the second most oil import-dependent country in the OECD before the first oil shock. Second, the imposition of such high taxes was not motivated by environmentalism per se, but by the need to reform the tax system in a more fiscally sustainable way. This involved taxation of what had become – after large reductions in oil use before 1990 – a relatively stable carbon tax base. And finally, while environmentalism did not cause the tax regime to be reformed in this way, it did motivate the form of the tax reform and advanced a political case for Pigovian environmental taxation.

Continuing with a Scandinavian theme in Chapter 13, Frede Hvelplund, Søren Djørup and Karl Sperling draw on multiple disciplines including social anthropology, politics and history to address a complex question drawing from the Danish experience. The question deals with overcoming path dependency in order to move economies to an 'integrated energy system', which is, they argue, what is needed for any modern economy to transition away from fossil-fuel dominant energy systems.

The authors note how Denmark transitioned to a decentralised heating model and the implications of this transition to that of an integrated energy system, one that they argue would apply to countries worldwide. The key to understanding how to move from a centralised to decentralised system is illustrated at three levels: the

normative, regulative and cognitive. In order to overcome the path dependency of centralised systems, they argue that policymakers may devise policies that transfer more responsibilities to ever more local stakeholders.

In Chapter 14 David Reiner, a political scientist, explores the example of carbon capture and storage (CCS) to show that it is not possible to explain how or why a specific energy technology is adopted in terms of technological feasibility alone but that grasping the broader social and political forces shaping support for it is essential. CCS has existed for decades and has many recognised advantages – for example, it is much less disruptive of existing energy technologies and business models than renewable technology and it can assist towards making rapid progress on climate targets. It is now seen as a vital element in any mitigation programme aimed at moving towards net-zero emissions. Yet, apart from a period of global political enthusiasm in the mid-2000s, it has struggled to secure a critical mass of advocates due to opposition, indifference or ambivalence from diverse stakeholder interests. Initial government support has waned and CCS has been disconnected from industrial policy; the technology struggles to demonstrate its potential profitability; energy utilities lack the resources even to assess opportunities; the shale gas surge undermined demand for coal generation and damaged coal industry profits; and the response of environmental NGOs has been divided and sceptical. The obstacles presented by these disparate interests have meant that, notwithstanding the promise of CCS to reduce energy costs substantially, this has not translated into the sustained, widespread support necessary to convince stakeholders that the initial high costs of large-scale projects will be worthwhile. CCS has rightly been described as an ‘orphan’ technology with ‘numerous well-meaning aunts and uncles but no parents’.

Chapter 15, by Atif Ansar, Dan Madrigal and Seth Collins, offers an examination of an emerging type of energy megaproject, data centres. Unbeknownst to many, the sector has grown over one thousand times from 2002 to 2018. As such, the demand for electricity that data centres put on existing power grids is a growing challenge for electricity providers. Drawing from business and management studies, the authors introduce the factors that are driving the growth of this sector. They note that although industry appears to have an insatiable thirst for electricity that will continue to present new challenges for providers, the efficiency of data centres is higher when compared to power demand from distributed computing. The authors point out that the key constraint in the growth of data centres is low-carbon energy; they then explore cases of high-profile data centres such as Facebook, Google and IBM. By identifying the factors that drive the selection of sites and the drivers of innovation in this field, they argue that co-locating data centres alongside onsite energy facilities offers the most promising options for overcoming the low-carbon energy constraint.

In Chapter 16, Leslie-Anne Duvic-Paoli, a legal scholar, explores the neglected role in discussions of energy governance of the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (the ‘Aarhus Convention’). The Aarhus Convention,

established pursuant to the concept of ‘environmental democracy’ affirmed in the 1992 Rio Declaration, is widely seen as an example of a best practice upon which to model ‘better’ global environmental policies, and energy activities are accorded a central place in its remit. The Convention is shown to be a novel instrument of global energy governance, challenging the traditional assumption that energy policy is a ‘*domaine réservé*’ of the state and thus moving beyond mere energy multilateralism. It also enhances concern with the public interest in policymaking and encourages the decentralisation of energy systems in the transition to a low-carbon economy.

The chapter assesses the central role of the Convention’s compliance committee. In two cases – the Hinkley Point nuclear power station and renewable energy policy in Scotland – the UK government was found to be non-compliant with the Convention. These and other cases disclose the committee’s potential as an instrument of environmental democracy while also revealing its limitations as a non-judicial body: its rulings are nonbinding, it possesses competence only over process and not substance, and it can only recommend future compliance not enforce redress of previous breaches. While questions remain over whether the motivations of citizen claimants are self-interested or oriented to the public good, Aarhus illustrates how international law can give citizens a forum that protects their right to democratic decision-making processes. It shows that energy governance is becoming more democratic, global and focused on sustainability, and shows that public participation as a principle of ‘good’ energy governance can lend energy decisions greater legitimacy and increase their social acceptance.

Chapter 17 considers one of the starkest examples of the damage that can be done by energy policy. Theologian Michael Northcott tells about the case of biofuels derived from palm oil plantations in Malaysia and the implications for the vulnerable in society, global justice and the impact on traditional ways of life. The impact in Borneo on wildlife is substantial (such as the decimation of the rainforest and that of the orangutan population, which have both been fairly well documented), but he focuses not just on environmental devastation and climate impacts, but also on the livelihoods of native groups. He traces how policy decisions made on the other side of the world in the European Union first encouraged this environmental devastation and then, after alarms were raised (and even then only after years had elapsed), stricter guidelines were enshrined, which helped discourage further exploitation.

Northcott highlights how the environmental disaster has been driven by ‘systemic political corruption, extensive criminal activity, and destruction of the habitats of native peoples and wildlife’. He also explores the role played by science as ‘an ambiguous handmaiden’ in the biofuels story. He highlights how the regional government (whose corruption has been exposed by investigative journalists) assumed the role of ‘trustee’ of the forests because it could claim the ability to take a modern approach in both managing and exploiting the island’s resources, thus eliminating the need to trust the more primitive aboriginal groups to act as guardians of the forests.

The final chapter in Part II, Chapter 18, continues with a theological theme. In his chapter on *Laudato Si'* – the far-reaching (and groundbreaking) papal encyclical on the environment issued by Pope Francis on the eve of the Paris climate negotiations in 2015 – political theologian Jonathan Chaplin provides a critical assessment of the substance of the document and the challenge of following through with action. He acknowledges some concrete manifestations growing out of the encyclical, such as the 'Laudato Si' Pledge' to mobilise Catholics on climate action and its inspiring of others to create a 'Laudato Si' Startup Challenge'.

Nevertheless, Chaplin highlights how there is still much more to be done to translate 'the inspiring content of *Laudato Si* into more specific strategic environmental and energy policy guidelines'. He describes the balance struck by Francis of highlighting the enormity of the problems and challenging the standard anthropocentric view while avoiding a bleak disempowering 'catastrophist' view. In this telling, Francis does well at the macro- and micro-levels to make the problems concrete but falls short at the 'meso level' by failing to offer solutions in terms of technology, states and markets.

The last part of the book, Part III, offers two intentionally multidisciplinary and international case studies. They were completed by two multidisciplinary teams examining clean air policies and a Eurasian pipeline policy with its ripple effects in the region. The editors, Michael Pollitt and Marc Ozawa who were contributing authors to these chapters, introduce the cases in Chapter 19. They offer an introduction to the topics, examine the distinction between multidisciplinary and interdisciplinary approaches and provide a practical reflection on the two different approaches used by the teams in the following two chapters.

In Chapter 20, Jacqueline Lam, Yang Han, Shan-Shan Wang, Victor OK Li, Michael Pollitt and Paul Warde offer a multidisciplinary chapter comparing energy policy in historical London with contemporary Beijing. The chapter brings together history, political science, economics and engineering approaches to urban air pollution arising from the burning of fossil fuels. Lam et al. begin by discussing London. Historical London was famous throughout the world for its 'fog', which was in reality black smoke or a form of particulate emissions from the burning of coal. In 1952 London experienced its 'Great Smog' over a four-day period which resulted in thousands of excess deaths. The reaction to this event resulted in the enactment of the UK Clean Air Act (CAA) of 1956, which for the first time gave local authorities the authority and resources to reduce air pollution. Subsequent to this there was a significant improvement in air quality in London as restrictions were placed on domestic and industrial coal burning. Lam et al. document this improvement and discuss why the policies the CAA promoted were effective.

The average annual concentration of black smoke or PM₁₀ dropped from two hundred micrograms per meter cubed in 1950 to around fifty by 1966 in London. Lam et al. show that in 2000 air quality in Beijing was roughly the same as in 1950s London, however, by contrast its air quality did not improve significantly in the

sixteen years to 2016. While the two cities bear striking similarities in their starting points both in terms of income per head and the level of air pollution, their situations are somewhat different. The sources of air pollution are different in the two cases: London's was coal for heating and power, while Beijing's recent air pollution is increasingly from vehicles and roughly one quarter of it is from industry in neighbouring provinces. Beijing has continued to grow rapidly in terms of population and GDP per capita, while London's population was very stable between 1950 and 1966, and GDP per capita growth was much lower. However, the persistence of Beijing's air pollution problem and the ineffectiveness of the many policies aimed at reducing it, are in striking contrast to the undoubted success of the CAA. Public outcry in London following the 'Great Smog' was important in the lead up to the CAA, whereas public pressure has been more muted in the case of Beijing. Effective enforcement of policies to reduce the local consequences of fossil fuel burning was possible in London and had a visible and material impact.

In the next multidisciplinary case study, Chapter 21, a group of six social scientists representing five disciplines, including Politics, Economics, Geography, Area Studies and Social Anthropology, examine natural gas pipelines as an energy policy. Marc Ozawa, Chi Kong Chyong, Caroline Humphrey, Kun-Chin Lin, Tim Reilly and Corine Wood-Donnelly begin by posing the question of whether natural gas pipelines as a policy are good for Russia. The case focuses on one of Russia's newest pipelines, the Power of Siberia, designed to deliver natural gas from newly developed in Siberia to the Chinese market, connecting the two countries by pipeline. The pipeline project has been in negotiations between the two countries for over a decade, but Russia's economic 'pivot to the East', which was in part a reaction to Western sanctions after the Ukraine crisis of 2014, brought a new level of importance to the project.

One distinctive advantage of multidisciplinary studies is the breadth and depth of the authors' ability to examine a policy from multiple perspectives and dimensions. This chapter takes full advantage of the authors' areas of expertise by investigating the commercial value of the project, which is perhaps the easiest aspect to characterise monetarily, the geopolitical implications, the project's impact on Russia's relations with its neighbours in the East particularly China, the pipeline's impact on local communities, and the environmental and legal-institutional constraints of building such megaprojects under a more authoritarian government. Given the multiple perspectives represented in this sort of collaboration, another advantage is that it allows for the testing of disciplinary concepts and assumptions.

The authors drew from their respective disciplines to create benchmarks for measuring positive aspects of the pipeline. These range from welfare effects and regional political power to political and community stability as well as environmental impacts. Considering these dimensions, the authors conclude that the Power of Siberia project, although in its infancy, appears to have a mixed track record. On the one hand, it provides both Russia and China with important market and

supply diversification. And although this contributes to greater energy security, the economic advantages look to be more one-sided, benefitting Russia in the short term but raising questions about the long-term viability of the project. The pipeline evades the scrutiny of international norms and legal frameworks, on which both countries seem to place less emphasis compared to similar pipelines connecting Russia to Europe. Related to this, the construction of the pipeline has not met the same international environmental standards of westbound pipelines, and this is adversely affecting indigenous communities in the Russian Far East. On a more global scale, however, the authors also raise the prospect of greater geopolitical instability in the region. As the Power of Siberia raises the energy supply independence of the region, there will be less of a need for the United States and other suppliers to maintain a presence in the region.

As we have provided the highlights of the book and our main conclusions drawn from the cases in this introductory chapter, Chapter 22 is devoted to responses by policy practitioners who have dealt with the realities of constructing and implementing policies. They include John Deutch, currently Institute Professor at the Massachusetts Institute of Technology and former Deputy Secretary of Energy in the United States, Emily Shuckburgh, OBE, deputy head of the Polar Oceans Team at the British Antarctic Survey and a former advisor to the UK Department of Energy and Climate Change and Lord Ronald Oxburgh, who is a British parliamentarian, member of the House of Lords, a former chairman of Shell and himself a geologist and geophysicist. These three ‘technologists’ provide three essays as perspectives on the topic of ‘good energy policy’. The last word, however, is reserved for us, the editors, who will respond to their comments and offer suggestions for future directions of multidisciplinary research in energy policy.