



H-Environment

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Christopher F. Jones, *Routes of Power: Energy and Modern America* (Harvard University Press, 2014). ISBN: 9780674728899

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Introduction by Jacob Darwin Hamblin, Oregon State University

Projections of future energy demand often drive arguments for increasing the pace of extraction or investing in infrastructure. Credible estimates of future demand are hard to come by, yet they are critical for justifying new ventures such as oil pipelines, fracking, or nuclear power stations. The International Atomic Energy Agency, for example, has invested considerable resources into finding plausible scenarios that require experts to make assumptions about future “social, economic and technological evolution,” so that the agency can use these projections to convince governments to adopt nuclear energy.¹ A different organization, the International Energy Agency—created in the wake of the 1974 oil crisis, to promote energy security among its members—in 2014 projected demand to grow by 37% by 2040.² As we imagine what kinds of energy choices to make today, we stare into the crystal ball of demand scenarios to try to predict the future.

Does our obsession with future energy demand blind us to the lessons of the past? In *Routes of Power*, **Christopher F. Jones** shows how the construction of new transportation networks sparked America’s appetite for abundant, cheap energy. Far from satisfying existing demand, these new “routes” established from 1812 to the Great Depression era transformed the United States in ways that no projections could have anticipated. The availability of new forms of energy—in other words, supply—explains historical trends better than assuming that a pre-existing trajectory of energy consumption had to be met.

Routes of Power already has won the 2015 Edelstein Prize, for outstanding scholarly book, from the Society for the History of Technology. His discussion of the nation’s first commercial oil pipeline was featured on National Public Radio’s [All Things Considered](#). Scholars will be discussing the book’s claims for many years to come.

I invited **Sarah Mittlefehldt** to comment on *Routes to Power* because of her current project on renewable energy advocacy, in which she explores the interface between environmental stewardship and civic engagement. She is Assistant Professor at Northern Michigan University. Her previous book, *Tangled Roots*, presents that relationship through a different kind of inter-state system—the Appalachian Trail—driven to completion by a network of people devoted to collective engagement with nature. Blending government leadership with local engagement, the trail’s path to development involved an extraordinary degree of public-private cooperation.³

¹ International Atomic Energy Agency, *Model for Analysis of Energy Demand (MAED-2) User’s Manual* (Vienna: IAEA, 2006). Available at http://www-pub.iaea.org/MTCD/publications/PDF/CMS-18_web.pdf.

² International Energy Agency, *World Energy Outlook 2014*

³ Sarah Mittlefehldt, *Tangled Roots: The Appalachian Trail and American Environmental Politics* (Seattle: University of Washington Press, 2013).

Our second commentator is **Gwen Ottinger**, whose work engages with the connections between the oil industry and environmental justice. She is Assistant Professor at Drexel University. Her book, *Refining Expertise*, shows how scientists' and engineers' portrayals of themselves as responsible, committed citizens undermined the ability of individuals near a Louisiana refinery to raise public health and environmental concerns. Ottinger's work highlights the impotence of local activism in the face of so-called corporate responsibility, and calls for greater public participation by citizens in crafting regulatory laws.⁴

Offering our third comment is **Stephanie LeMenager**, the Barbara and Carlisle Moore Professor of English and Environmental Studies at the University of Oregon. Her book *Living Oil* is a cultural study of the legacies of petroleum, drawing on museum exhibits, films, photography, fiction, and several other sources. In addition to revealing how oil is a dominant force in shaping American culture, she calls attention to today's era of "Tough Oil," marked by the attempts to continue American lifestyles amidst increasing environmental and human costs.⁵

Our final commentator is **Sara B. Pritchard**, Associate Professor of Science and Technology Studies at Cornell University. Her work on "envirotech" explores the nexus of environmental history and STS. Her book *Confluence* examined nuclear power development in France, particularly developments along the Rhône River. She shows just how ineffective local actors were in highlighting negative effects of environmental transformation or in resisting changes that were mandated by a centrally planned state.⁶

Before turning to the comments, I would like to pause here and thank all the roundtable participants for taking part. In addition, I would like to remind readers that as an open-access forum, *H-Environment Roundtable Reviews* is available to scholars and non-scholars alike, around the world, free of charge. Please circulate.

⁴ Gwen Ottinger, *Refining Expertise: How Responsible Engineers Subvert Environmental Justice Challenges* (New York: New York University Press, 2011).

⁵ Stephanie LeMenager, *Living Oil: Petroleum Culture in the American Century* (New York: Oxford University Press, 2014).

⁶ Sara B. Pritchard, *Confluence: The Nature of Technology and the Remaking of the Rhône* (New York: Harvard University Press, 2011).

Comments by Sarah Mittlefehldt, Northern Michigan University

What can historians contribute to discussions about sustainability? In *Routes of Power*, Christopher F. Jones gives us a tangible example of how to connect environmental past to the present, and demonstrates the importance of thinking about energy transitions not only as shifts in technology and fuel types, but as changes in infrastructure and land use that are in dialectical relationship with underlying political and cultural dynamics. This book is essential reading for anyone interested in the geopolitics of energy and the rise of fossil fuel-based energy systems in the late-nineteenth and early-twentieth centuries.

Jones explains the shift from “organic” to “mineral” energy regimes in a series of compelling chapters that are organized in loose chronological order. Chapter one begins with an exploration of coal canals and the transformation of wild eastern rivers into a transportation network for a new energy source: anthracite coal. After explaining how residential homes helped to shift the country’s energy economy from a nation based on wood to one based on fossil fuels in the second chapter, Jones moves on to explain Pennsylvania’s petroleum boom in chapter three and examines power dynamics and pipeline development in chapter four. Chapters five and six are devoted to hydroelectricity and the expansion of early electrical grids in the East. This clearly defined structure helps to ground Jones’s main ideas about the hidden human dimensions of energy transitions.

One of Jones’s main points is that “energy transitions are overlapping and reinforcing” (232). This seems particularly relevant to contemporary conversations that emphasize the diversification of energy options. Renewable energy advocates today often emphasize that the solution to our energy problems will not involve finding a “silver bullet” to replace fossil fuels. Instead, the solution will look more like “silver buckshot.” Just like in the past, we are currently undergoing a series of “overlapping and reinforcing” energy transitions. The role of policy makers is to ensure that the ways in which different energy technologies overlap and reinforce one another are environmentally and socially responsible. Those who craft energy policy today would learn much from Jones’s historical account of past energy transitions in *Routes of Power*.

Perhaps one of the most hopeful findings in *Routes of Power* is that “energy transitions were often driven by supply rather than demand (5).” In the case of anthracite coal, oil, and hydroelectricity, energy boosters had to make consumers want, and even need, their products. Although much of the book focuses on broader decisions about infrastructure and technology, this key point may help to empower readers—particularly students, who are often inundated with information about structural changes that seem beyond their control. Jones points out that while large-scale decisions about energy infrastructure lay the foundations for changes in fuel

types and technology, developing markets for new fuels required the creation of consumer demand. In effect, consumers—everyday citizens—had some sense of agency in the process of shifting from organic to mineral energy sources. Of course, as Jones points out, energy boosters were extremely effective at turning what began as a non-existent desire for new energy sources into widespread need.

One particularly important theme in *Routes of Power* is that energy infrastructure—canals, pipelines, electrical wires—structured benefits and burdens in unequal ways. For example, in Chapter 2 Jones explains that while anthracite coal helped to power the US into the global market, “the benefits and costs of [those] changes were not distributed equally (60).” Later, in the context of oil and hydroelectricity development, Jones also explains how rural sites of resource extraction became energy sacrifice zones. Anyone interested in environmental justice and its historical precedents would appreciate Jones’s effort to examine the winners and losers of modern energy systems. Yet I would have liked to see Jones’s analysis go even further to provide a more textured look at how the shift from organic to mineral forms of energy distributed benefits and burdens. Who were those people living in the sacrifice zones created by the “mineral energy regime”? How did residents within Pennsylvania’s oil regions react to the explosion of new development? How did landowners react to exploding pipelines? What were the opinions and perspectives of urban residents who lived near refineries? Although hinted at throughout this book, a deeper social history would have helped to flush out the narrative and strengthen this part of Jones’s argument. Perhaps that is not the main purpose of this text, but without out a clearer sense of the human stories of those affected by new energy infrastructure, this part of Jones’s argument is left dangling in abstraction.

Jones does make an attempt to examine how past energy transitions have affected gender dynamics in chapter 1, when he explains how the shift from organic to mineral energy regimes changed the role of men and women’s labor in and outside of the home (222). But this analytical thread is lost in later chapters. How did the rise of petroleum and hydroelectricity affect the roles of men and women in the late-nineteenth and early-twentieth centuries? Certainly this could be the topic of an entirely different book, and Jones has done an excellent job in opening up avenues for future researchers to explore.

Despite my desire to know more about the people affected by the energy sacrifice zones that Jones describes, I highly recommend this book to anyone teaching the history of energy. The book raises excellent questions about current energy systems, and provides a compelling explanation of how energy infrastructure developed in the nineteenth century paved the way for a twentieth-century economy based on fossil fuels. As we negotiate energy transitions in the twenty-first century, understanding this past is essential to thinking about possible futures.

The value of *Routes of Power* as a teaching tool became apparent to me in the fall of 2014, when nearly a hundred students and I got on a bus and drove to New York

City to participate in the People's Climate March. During the experience, I had several conversations with young people who yearned to understand the origins of climate change. They wanted to know how fossil fuels came to power a global economy that has led to so many social and environmental problems, and why it has been so difficult to navigate a different energy path. I decided I needed to design and teach a new course on the geopolitics of energy that would examine the historical development of different energy regimes, and the social and political factors that shaped energy systems.

In developing this new course, I didn't want to use alarmist books by notable environmentalists. I wanted to provide students with a thoughtful and critical look at the complicated political dynamics surrounding energy development. I wanted a text that would help me to engage students in thinking about the underlying causality involved in transitioning from one energy system to another. *Routes of Power* was the perfect book to begin such a course. My students loved this book and how it changed the way they thought about energy systems. One student who majored in Renewable Energy and Ecological Design commented that she had spent four years learning about the economic and technological dimensions of energy systems. In a reflection paper, she wrote: "*Routes of Power* offers a perspective I have never encountered before.... Most of my education has focused on *how* fossil fuels power our world, but not necessarily *why*." Like me, she was impressed by how this book helped her to think about energy transitions not only as technological change, but also as deeper shifts in culture, ideas, and politics. Such a realization is critical to understanding how and why climate change has become such a complex and pervasive problem in the twenty-first century.

In explaining the rise of coal, oil, and electrical power in the Mid-Atlantic region, Jones tells a much broader origin story about the dawn of the fossil fuel era—and era that has left an indelible mark on global ecosystems. This origin story reveals how energy transitions are based upon changes in lifestyles, ideas, and values. Energy transitions are not about abstract technological changes; energy transitions are social and political, and even deeply personal. This book illustrates the important human dimensions of energy systems and helps to pioneer new frontiers for energy researchers.

Comments by Gwen Ottinger, Drexel University

I read *Routes of Power: Energy and Modern America*, appropriately enough, on a trip from the front lines of America's current energy transition to a second front line in America's current energy transition. My journey began with a pre-dawn cab ride that took me past the Philadelphia Energy Solutions (PES) refinery, its processing units aglow and a cloud from its stacks shimmering silver against the dark sky. Spanning the Schuylkill River in close proximity to the dense residential neighborhoods of southwest Philadelphia, PES is regarded by many government and business leaders as an anchor of the "energy hub" that the city (or at least a powerful group of the city's elites) aspires to be. As an energy hub, Philadelphia would route petroleum-based fuels and feedstocks to domestic and especially international markets. Notably, the petroleum products arriving in the city would be products of what's known as "unconventional oil and gas development" (UOGD), including propane-rich crude oil from North Dakota's Bakken shale, which PES currently refines, and natural gas produced by controversial hydraulic fracturing (fracking) processes in the nearby Marcellus shale.⁷

Philadelphia's energy hub ambitions hinge on the area's transportation infrastructure: development plans include building new pipelines and shipping terminals, while those opposed to the energy hub raise questions about the safety of old rail cars and poorly maintained railroad tracks.⁸ The importance of pipelines, rail lines, and terminals will come as no surprise to readers of Christopher F. Jones's history of an earlier energy transition, the late 19th-century shift from an "organic energy regime" to a "mineral energy regime." Starting around 1860, anthracite coal, oil, and eventually electricity came to replace wood, sunlight, and muscle as sources of heat, light, and power for transportation and industrial production. While organic sources of energy are subject to natural limits—e.g., the length of a winter day, the growth rate of an acre of forest—coal and oil are stored-up forms of energy that can be used at a greater rate than they are produced. Jones's book shows how this characteristic enabled energy-intensive industries like steel and aluminum to grow exponentially, cities to expand, and urbanites to travel further, heat their homes more effectively, and remain active later into the evening.

It would be easy to claim that the transition to mineral sources of energy occurred *because* they were able to transcend the limits of organic sources at a time when the American population was growing. But Jones paints a more complicated picture:

⁷ John Hurdle, "What's at stake if Philly becomes an energy hub?" *City Paper*, November 26, 2014.

⁸ Hurdle, "What's at stake"; Patrick Kerkstra, "You can't do it safely," *Philadelphia Magazine*, January 14, 2015, <http://www.phillymag.com/citified/2015/01/14/philadelphia-energy-hub-environmentalists-qa/#more-2894966>; Joel Mathis, "Philadelphia and the 'Bomb Trains,'" *Philadelphia Magazine*, February 2, 2015 <http://www.phillymag.com/news/2015/02/02/philadelphia-crude-oil-bomb-trains/> (accessed April 3, 2015).

the success of the mineral energy regime, he shows, depended on producers' ability to move energy sources to consumers economically. Anthracite coal was not a new discovery when it first started to see widespread use; it just didn't go anywhere (figuratively or literally) until canals were built to transport it to population centers at a price that could rival firewood. Similarly, the commercial viability of oil was so dependent on railroads that the only hope of breaking Standard Oil's monopoly was to build an alternative mode of transportation—pipelines—that could move oil for a lower cost.

Jones makes three overarching points about transportation infrastructures that are critical to understanding the nature of energy transitions, past and future. First, where energy resources must travel over long distances, it often—perhaps usually—makes sense to build new routes for its transit alongside the old ones. Railroad builders had to find paths over difficult terrain and negotiate private property rights; for subsequent pipeline builders, rail lines were an obstacle but railroad easements were a resource. Second, the large investments that energy producers had to make in transportation infrastructures motivated them to aggressively develop markets for their products, and created supply-demand feedback loops that caused use of mineral energy sources to escalate rapidly and continue to grow, arguably to this day. Finally, the particular technologies that constituted the new “routes of power” not only shaped the landscape but also created winners and losers: Jones is attentive to how urban areas, where energy consumption was concentrated, benefited from the energy transition at the expense of (rural) sites of extraction, as well as how railroads created a variety of benefits for a larger number of areas than did one-way pipelines. Further, in documenting the lengths that John D. Rockefeller went to defeat Byron Benson's pipeline, Jones highlights how much is at stake for capitalists invested in a particular form of energy when even a limited transition looms.

These points stayed with me as I reached the end of my journey. After landing at the San Francisco airport, I drove across the Bay Bridge and followed I-80 up the east side of the Bay, passing the racially diverse town of Richmond, where poverty rates approach 20% and the Chevron oil refinery is the largest employer by far, enjoying the view of the Carquinez Strait with Phillips 66's Rodeo refinery in the foreground, and finally crossing another bridge into the town of Benicia, formerly the site of an Army arsenal that employed several thousand people during World War II and now home to a Valero refinery. At the city's Senior Center on a beautifully sunny evening—one symptom of a historic drought that has created a sense of urgency about action on climate change throughout the Bay area—residents of Benicia have gathered to talk to regulators about the area's ongoing energy transition. But the public meeting that I have come to attend is not primarily about transitioning to sustainable energy; rather, it is about the same transition that has been fueling Philadelphia's energy hub aspirations—the replacement of traditional sources of oil with the products of unconventional oil and gas development. The meeting is being held by the Bay Area Air Quality Management District (BAAQMD) to get feedback from the public on two proposed refinery rules, which would apply

to the Benicia, Rodeo, and Richmond refineries, as well as two others in nearby Martinez. The residents in attendance, along with their allies from an Oakland-based environmental justice non-profit, do comment on the need to move away from fossil fuels. But their acute concern is with the local refineries' desire to process crude from the Bakken shale and the Canadian tar sands.

Jones might be gratified to know that his arguments about dynamics of energy transition are just as applicable to California in the early twenty-first century as they were in the Mid-Atlantic in the late nineteenth. Transportation is key: the most pressing issue for Benicia residents is Valero's proposed "crude-by-rail" (CBR) project, which would bring oil from the Bakken shale into the refinery in long chains of tanker cars. As in Philadelphia, residents question the safety of CBR, dubbing the rail cars "bomb trains"; for Valero, CBR means maximizing its "flexibility" with respect to inputs, allowing it to pursue a competitive advantage by buying whatever fuel is cheapest. Moreover, supply continues to drive demand: as Californians use less energy, refineries here are increasingly finding markets in China and elsewhere in Asia—and activists warn that the Bay area will become a "sacrifice zone" for world energy markets, underscoring Jones's point about geographical winners and losers. The power of infrastructural investments to shape future policies is also recognized in the public comments, with members of the public urging the BAAQMD to change a provision that would allow refineries to calculate the economic feasibility of emissions reductions after new rail lines and terminals have already been built.

Yet this is not the kind of contemporary relevance than *Routes of Power* hopes to achieve. By drawing out a series of "patterns" to be found in energy transitions, Jones wants to suggest ways that policy makers could better promote a transition to sustainable energy—a transition which, he points out, will necessarily entail a return to organic energy sources. His suggestions are thoughtful and well grounded, as far as they go: he notes that particular attention needs to be paid to constructing transmission lines, that steps should be taken to ensure equity in new energy systems, and that governments should play an active role in rolling back policies that favor fossil fuels and creating new policies to incentivize renewable energy development.

However, in looking for a path to sustainable energy, I think that Jones misses some of the more troubling implications of his own analysis. New energy infrastructures *do* follow the same routes—both material and political—carved out by old ones; as a result, discussions about renewable energy, including Jones's, overwhelmingly focus on transmission lines and concentrated sources of production, a pattern guaranteed to create new sacrifice zones.⁹ Further, operating within that framework, policies to

⁹ Gwen Ottinger, "The Winds of Change: Environmental Justice in Energy Transitions," *Science as Culture* 22(2013): 222 – 229; Sujatha Raman, "Fossilizing Renewable Energy," *Science as Culture* 22(2013): 172 – 180.

incentivize renewables may create procedural injustices that go hand-in-hand with the material inequities that Jones discusses.¹⁰

On-going fights over UOGD bring into focus an additional pattern visible in Jones's analysis but not drawn out explicitly in his conclusions: winners in one energy regime will go to great lengths to undermine transitions which might destabilize their position. Just as Rockefeller's railroad syndicates ripped up lengths of completed pipeline, deliberately lost shipments of materials, and physically intimidated pipeline workers, petrochemical companies are working to beat back innovation, movements, and especially laws that would advance renewable energy at their expense. In the Bay area, representatives of the Western States Petroleum Association have been fixtures at every meeting on new refinery rules, and environmentalists charge that they are working behind the scenes to ensure loopholes that effectively defang the rules stay in place. In the terms of Jones's analysis, the social power that they have gained in the transition to mineral energy positions them to block a transition to sustainable energy, in part by wielding significant influence over policies that could support a transition.

Finally, taking seriously the conclusions that supply drives demand and that energy systems are overlapping brings into focus the danger that the "transition" to sustainable energy may not, in fact, involve a move away from fossil fuels. In seeking markets for their product, renewable energy producers may in fact be generating brand-new demand, just as coal and oil proponents did in the 19th century, just as oil companies faced with a glut of supply from UOGD are doing in cultivating foreign markets. As long as they are based in a free-market logic, then, incentives for developing renewables may simply escalate overall demand for energy rather than reducing and displacing demand for fossil fuels.

In sum, *Routes of Power* not only succeeds admirably in showing how the United States transitioned from an organic energy regime to a mineral one; it also offers analytical tools for understanding how contemporary energy transitions are proceeding—and where and why they stalling out. The one weakness of the book is its reluctance to recognize the import of its own conclusions. In highlighting structural reasons for environmental inequity and ever-increasing demand for energy, the book suggests that a transition to a just, sustainable energy regime calls for a radical rethinking of taken-for-granted aspects of our energy systems, including the centrality of the free market and the centralization of energy generation.

¹⁰ Gwen Ottinger, Timothy Hargrave, and Eric Hopson, "Procedural Justice in Wind Facility Siting: Recommendations for State-led Siting Processes," *Energy Policy* 65(2014): 662 – 669.

Comments by Stephanie LeMenager, University of Oregon

Infrastructure, infrastructure, infrastructure. This is the mantra of Christopher F. Jones' sweeping study of how America's modern energy system came to be. Jones' *Routes of Power: Energy and Modern America* (Harvard, 2014) contributes to a lively debate within a new interdisciplinary field known as "the energy humanities" including historians, geographers, anthropologists, artists, and cultural critics like Matthew Huber, Timothy Mitchell, Imre Szeman, Ursula Biemann, Dominic Boyer, Kathryn Yusoff, and myself. Jones is an assistant professor at Arizona State University who blogs about contemporary energy politics and topical matters such as "energy gluttony" for the *Huffington Post*. The conversational tone of the blogger is absent from *Routes of Power*, which reads as an historian's history. In *Routes*, Jones offers a fine-grained, deeply researched analysis of successive energy transitions in the U.S. mid-Atlantic region from 1820 to 1930.

The inter-disciplinary reader accustomed to analytical muscle or stylized writing might get bogged down in Jones' technical descriptions. For example, "the Tide-Water's engineers developed a tri-plex pump that maintained a steady output of pressure through the use of three pistons timed to rise and fall at different times," about an early pipeline project (130). Yet this precision, even when tedious, pays off, because such attention to detail allows Jones an indisputable argument for how unnatural and far-from-inevitable our modern fossil fuel system has been. The great gift of Jones' book is its historical break-down of entrenched habits of energy consumption, transport, and use into a series of difficult, haphazard, and at times accidental encounters between individuals and institutions intent upon finding markets for initially problematic resources like "sour" crude—which was reimagined as gasoline fuel but began its career as an inferior home lighting oil because, unlike the less-sulfurous "sweet" crude preferred for making kerosene, it stank. "Skunk juice was much less like mahogany and a lot more like pinewood," Jones writes of sour crude, in a discussion of how Ohio oilmen scrambled to create markets for the sour crude of Lima, Ohio, as a cheap fuel for factories (149). Once Standard Oil built a pipeline from Lima to Chicago, the fate of Lima crude—and the ascension of petroleum fuel to a mainstay in industrial production—was assured, and, seemingly, inevitable.

The story of Lima crude is one among many in *Routes of Power* wherein a relatively small number of ambitious boosters work feverishly to create a local market for a new energy source, then that market attracts the attention of a heavily capitalized entity like Standard Oil which underwrites a transport infrastructure whose sunk costs guarantee the continual cultivation of markets farther afield. "Supply fueled demand," Jones writes, "demand fueled supply, and increases in the capacity of canals, pipelines, and wires sustained these feedback loops" (9). Infrastructure, Jones reminds us, happens because people make it happen, and, at least in its earliest stages, it takes a tremendous amount of work. Following Richard White's

foundational discussion of energy as a kind of labor that obscures the embodied experience of work in *The Organic Machine*, Jones speculates on the ways in which “organic energy regimes” and “mineral energy regimes” distinctly exploit, and supplant, human and animal labor. How fossil fuels changed the status of work, for better and for worse, has been taken up in regard to the switching out of chattel slavery to cheap fuels, or “energy slaves,” by (among others) Jean-Francois Mouhot, Andrew Nikiforuk, and myself in *Living Oil: Petroleum Culture in the American Century* (Oxford, 2014). Not only did fossil fuels make slavery a less desirable economic solution to global labor demands, Jones argues, but the kerosene market also might have saved some species of the world’s whale populations from extinction. The whaling industry had peaked in 1846 and was being forced to travel longer distances for prey by the 1850s—an era of extreme whale oil, if you will. Electric power made factory work safer, eliminating spinning belts and line-drive systems responsible for many industrial accidents. Yet electrification also made possible the assembly line, its exhausting pace and dullness.

In many respects, the transition from an organic to mineral energy regime created unexpected human and ecological sacrifice. Every successive transition to a new form of mineral energy has required tremendous inputs of human and animal muscle. No small feat the digging of canals to barge coal or the laying of oil pipelines or the construction of electrical transmission towers. “The steel bars for the towers were hoisted into place using ropes and pulleys,” Jones begins, in a close description of erecting an electrical tower that ends with a worker being killed by dynamite (181). Never absent from the scene of “mineral energy,” muscle work tends to disappear at the sites of energy’s consumption, which were overwhelmingly urban until roughly the endpoint of this study, in 1930. Especially after the construction of oil pipelines—which began in a modest form in the 1860s—the fate of energy extraction regions as under-developed sacrifice zones seemed assured. In one of the close observations that makes his study so valuable, Jones reminds readers that typically “pipelines carry a single product in a single direction to a single point,” taking non-renewable resources away from producing regions without creating a reciprocal trade in goods, as some older energy transport infrastructures, such as canal systems for barging coal, had done (141). Similarly Jones touches upon the well-known externalities of hydro-electric development, in this case the injury to the shad fishery and recreational values of the Susquehanna River resulting from dam construction. The final chapter of *Routes of Power* describes a national effort—led by Gifford Pinchot, of forestry fame, to democratize access to electricity such that “the drudgery of human life” could be largely eliminated from rural regions (208). Although Jones avoids anachronistic frames like “environmental justice,” his book makes clear how distributional inequities and ecological burdens developed through the successive transitions (coal, oil, gas) of the mineral energy regime.

Jones focuses less on the cultural effects of energy transitions than on the ways in which those transitions come about through the work of economic actors and alterations to the transport sector. Nonetheless the cultural repercussions of these transitions are noted—and more can be inferred from what is not said. Jones ought

to be read alongside Matthew Huber's *Lifeblood* (2013), especially Huber's chapter on how the New Deal—where Jones's book leaves off—created “a new geography of everyday life.”¹¹ Where Huber isn't afraid of strong insights, such as that the idea of “the home” anchored the material transformation to a fossil fuel lifestyle and the “second frontier expansion of American history,”¹² Jones's insights into cultural transformation remain modest. As *Routes* concludes, Jones treats the reader to a careful account of how electrification fed the streetcar industry, and how streetcars in turn enlarged urban circumference—reminiscent of John Stilgoe's now classic *Borderland: Origins of the American Suburb* (1989), although Stilgoe is more interested in cultural values like aesthetics. Tracing the rise of electricity use in the domestic residence, Jones makes clear exactly when (circa the 1920s) the appliance became an indispensable part of American experience. Moreover, he offers a brief gloss on what we might call mineral leisure—the new possibilities for family outings enabled by streetcar service, like amusement parks, and the wide distribution of radio as the United States' premier form of home entertainment.

For this reader what remains most significant and even startling about Christopher F. Jones' *Routes of Power* has to do with, again, the work and difficulty of making any energy regime entrenched—the fact that the “reign” of coal or oil, for instance, began fairly locally, in mid-Atlantic producing regions, and was in its early phases the product of a relatively small number of ambitious boosters and transport technicians. Although Jones, at least with his historian's hat on and his *Huffington Post* hat off, eschews presentism, it's of course tempting to recognize in these narratives of how unlikely energy systems are made “inevitable” a rather hopeful prescription for how to transition into another, post-peak-oil energy regime. While *Routes of Power* is no guidebook for such a politics of energy transition, it makes clear that, at least historically, small groups of advocates could change the infrastructure, and thus the world.

¹¹ Matthew T. Huber, *Lifeblood: Oil, Freedom, and the Forces of Capital* (Minneapolis: U of Minnesota, 2013) 41.

¹² Huber 39.

 Comments by Sara B. Pritchard, Cornell University

Situating *Routes of Power* within the History of Technology

Christopher F. Jones's new book, *Routes of Power: Energy and Modern America*, explores the history of energy transport infrastructure in the mid-Atlantic United States between the War of 1812 and the Great Depression.¹³ It is organized by pairs of chapter on energy type (coal, oil, hydroelectricity). The first chapter examines the emergence of transportation technology for each energy source (canals, pipelines, and transmission wires), while the second considers the deepening or—in Jones's terms—intensification of its importance to American society and political economy. The book concludes with seven patterns of energy transitions garnered from this case. Overall, *Routes of Power* is a valuable piece of historical scholarship written for a broader audience and explicitly motivated by contemporary concerns. Jones also writes about energy issues for the Huffington Post; his Twitter handle is "@EnergyHistorian."¹⁴

Within academic scholarship, *Routes of Power* is in conversation with an impressive number of fields, including energy history, environmental history, the history of technology, envirotech, science and technology studies (STS), the history of American industrialization, business history, and the history of capitalism. Jones's engagement with these fields is at times explicit, other times implicit, and sometimes found in the notes. My contribution to this H-Environment roundtable will situate his book primarily within the history of technology.

Routes of Power exemplifies newer scholarship on energy and society in historical perspective. Jones investigates the roots of our energy-intensive world and how it came to be. He studies not only the shift to, but also growing dependency on, fossil fuels in the United States between the early nineteenth and early twentieth centuries, focusing on the transition from what he calls an "organic energy regime" to a "mineral energy regime." Jones highlights the importance of energy transport systems in both reflecting and facilitating rising energy use over the nineteenth century. In the process, he demonstrates how earlier energy transport networks often shaped later systems.

Readers familiar with the history of technology will recognize the influence of Thomas Parke Hughes in Jones's analysis, especially the former's concepts of sociotechnical systems and momentum.¹⁵ Jones convincingly argues that transport technologies should be included in systems, and his discussion of fossil fuel

¹³ Christopher F. Jones, *Routes of Power: Energy and Modern America* (Cambridge, MA: Harvard University Press, 2014).

¹⁴ <http://www.huffingtonpost.com/christopher-f-jones/>

¹⁵ Thomas Parke Hughes, *Networks of Power: Electrification in Western Society, 1880–1930* (Baltimore: Johns Hopkins University Press, 1983). Of course, Jones's book title plays on Hughes's.

“synergistic feedback loops” is informed by Hughes’s idea of momentum, as well as STS scholarship on co-production and infrastructure.¹⁶

Jones also builds on work in the history and sociology of technology over the past generation that has complicated our understandings of technological development. Academic studies have generally (and thankfully) moved beyond heroic tales of genius inventors to consider technical change as a nonlinear process in which design, development, production, consumption, and disposal involve many social groups and iterative dynamics.¹⁷ In his study, Jones calls attention to transportation technologies that moved first coal, then oil, and finally electricity—usually from more isolated, rural areas rich in energy resources to industrial, urban centers along the mid-Atlantic coast. Indeed, Jones argues that they could become metropolises thanks to fossil fuels and the “routes of power” that brought concentrated energy reserves into manufacturing and population centers.¹⁸ Jones makes a strong case that the role transport infrastructure plays in energy systems has been inadequately appreciated. For instance, although discussions of coal often focus on mining and therefore production, Jones found that “Financially, the investments in the transport of coal far exceeded the investments in coal mining. By 1834, for example, over \$9,750,000 was invested in transport infrastructure in the anthracite regions while only \$1,270,280 was devoted to the mines themselves (and much of this capital was spent on boats and wagons).”¹⁹

In addition to Hughes and more nuanced models of technological change, Jones builds on scholarship by historians of technology who have traced how boosters, mediators, and “agents of diffusion” help align technological demand with its supply. This scholarship has shown how new technological artifacts were not always heralded icons of modernity that users quickly adopted. Instead, marketers and extension agents frequently had to actively cultivate users and consumption.²⁰ As Jones succinctly puts it, “supply drove demand.”²¹ *Routes of Power* confirms this was also true for new kinds and quantities of energy. In one telling example, energy

¹⁶ On co-production, see Ronald R. Kline, *Consumers in the Country: Technology and Social Change in Rural America* (Baltimore: Johns Hopkins University Press, 2000); Sheila Jasanoff, *States of Knowledge: The Co-Production of Science and Social Order* (New York: Routledge, 2004). On infrastructure, see Susan Leigh Star, “The Ethnography of Infrastructure,” *American Behavioral Scientist* 43:3 (1999): 377-391; Paul N. Edwards, “Infrastructure and Modernity: Force, Time, and Social Organization in the History of Sociotechnical Systems,” in *Modernity and Technology*, ed. Thomas J. Misa, Philip Brey, and Andrew Feenberg (Cambridge, MA: MIT Press, 2003).

¹⁷ Jones does frequently use “pioneers” and “pioneering efforts” to describe energy transport entrepreneurs and their endeavors. Such terms tend to evoke heroic (masculinist) inventors and inventions. For instance, in Chapter 5, see 163, 164, 167, 172, 183, and 193.

¹⁸ Jones, 64.

¹⁹ Jones, 57.

²⁰ Carolyn M. Goldstein, “Home Economics: Mediators,” in *Gender and Technology: A Reader*, ed. Nina E. Lerman, Ruth Oldenziel, and Arwen P. Mohun (Baltimore: Johns Hopkins University Press, 2003); Kline, *Consumers in the Country*; Ronald R. Kline, “Home Ideologies: Progress?,” in *Gender and Technology*; Mark Rose, *Cities of Heat and Light: Domesticating Gas and Electricity in Urban America* (University Park: Pennsylvania State University Press, 1995).

²¹ Jones, 232. See also 5.

boosters (foremost, corporate players with vested economic stakes in increasing energy consumption) had to teach industrial and domestic adopters of anthracite coal in Philadelphia how to burn it.²²

Three concepts anchor Jones's analysis: 1) energy transitions; 2) organic energy and mineral energy regimes; and 3) landscapes of intensification. The rest of my review essay will focus on these analytic tools. I consider how these concepts enrich our understanding of "energy history," while raising several questions for related and future scholarship.

Central to Jones's book is the idea of energy transitions. Of note, this is a recent term the author uses to frame his study; it is not an actors' category and, as Jones explains in the Introduction, "definitions vary."²³ In Jones's case, energy transition can be used to characterize the shift from organic energy sources such as animal and human labor to a mineral energy regime centered on coal, oil, and, Jones asserts, hydroelectricity. Although Jones is a historian and his study focuses on nineteenth-century America, contemporary debates about future energy transitions loom just beneath the surface of his narrative. Indeed, the Introduction and Conclusion explicitly reference present anxieties about "the next" energy transition, given global climate change and questions about waning fossil fuel supplies.

However, Jones goes beyond historicizing energy transitions and the roots of modern energy consumption. By looking at the history of energy broadly and energy transport specifically in "modern America," Jones connects such energy transportation infrastructure to larger historical processes and patterns in the nineteenth century, including industrialization, urbanization, and capitalism. He argues that the shift to a mineral energy regime, including construction of the transport infrastructure on which it depended, enabled and ultimately helps explain significant political, economic, cultural, and technological change. Moreover, energy consumption patterns in the mid-Atlantic were not only indicative of national trends, but also offered expertise for other parts of the country.²⁴

Although the word "transition" is clearly process-oriented, too often it can imply a tidy shift from "a" to "b," rather than describe a contested, messy, nonlinear process of incremental change that requires considerable work of various sorts (political, cultural, technological) to accomplish. Herein lies one of the strengths of Jones's study: he shows in empirical detail how nineteenth-century energy transitions were "neither natural nor inevitable."²⁵ This point leads me to Jones's next concept.

²² Jones, 34. For coal, see also 46; for electricity, see 186.

²³ Jones, 5. Of note, the concept of energy transitions could certainly be historicized and problematized, although it is beyond the purview of Jones's book and therefore my review.

²⁴ Jones, 3.

²⁵ Jones, 2.

Jones historicizes the general idea of energy transitions by developing two related analytic tools: organic energy regime and mineral energy regime. Jones's discussion of both regimes, as well as the shift from the former to the latter, echoes Robert Marks's idea of the biological old regime.²⁶ In *The Origins of the Modern World* (2002), Marks argued that industrialization enabled western Europe and eastern North America to exceed the historic constraints of annual solar flows and the limited ability to store energy reserves. As Jones emphasizes in his study, organic energy regimes restricted economic growth and population density. These regimes were geographically bounded as well. Both Marks and Jones therefore highlight the temporal, spatial, and ecological limits of organic energy regimes. These constraints become more apparent by considering how energy regimes centered on fossil fuels tap the extraordinary energy reserves of deep geologic time. Put another way, organic energy and mineral energy regimes describe the historical shift from energy flows to energy stocks.²⁷

By teasing out how the organic and mineral energy regimes worked in the nineteenth-century mid-Atlantic, Jones offers several insights, three of which I feature here. First, although the historical trajectory of the nineteenth century marked an eventual shift from organic energy sources to fossil fuels, this transition was neither smooth nor complete.²⁸ Jones's book offers many examples, but to cite just two, "Canals supplied the mid-Atlantic with mineral energy, but as with mining coal, their success relied on the powers of the organic energy regime. Humans and animals labored long and hard to haul boats up and down the region's improved waterways."²⁹ Even more dramatically, oilmen turned the aptly named Oil Creek into "the world's first petroleum highway."³⁰ Thus, as with many analytic categories, the terms organic energy regime and mineral energy regime reinforce a tidy binary that obscures more complex, on-the-ground dynamics.

Second and relatedly, Jones shows how nineteenth-century mid-Atlantic energy regimes were frequently amalgams of both organic and fossil fuel energy sources. He occasionally uses "hybrid" or "blend" to describe such regimes.³¹ Their hybrid character suggests how energy transitions were very much transitional. For example, as mentioned above, getting coal from mines to early canals continued to rely on human and animal labor. In the early twentieth century, hydroelectric dams on the Susquehanna River may have harkened back to organic energy regimes, but

²⁶ Robert Marks, *The Origins of the Modern World: A Global and Ecological Narrative* (Lanham, MD: Rowman & Littlefield, 2002); the second edition was published in 2006 and the third released in early 2015. See Chapter 1, note 20 for Jones's discussion of Marks, related scholars (including E.A. Wrigley, Rolf Peter Sieferle, and John McNeill), and their respective concepts.

²⁷ Jones, 18.

²⁸ On the emphasis on shift in the Introduction, see Jones, 3, 14, and 18.

²⁹ Jones, 56. For a few other examples, see 42, 67, 81, 97, 123, and 181.

³⁰ Jones, 99.

³¹ On hybrid, see Jones, 67, 163, and 236. On blend, see 123 and 183. On hybrid landscapes, see Mark Fiege, *Irrigated Eden: The Making of an Agricultural Landscape in the American West* (Seattle: University of Washington Press, 1999); Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995).

ultimately they were integrated into a larger energy system defined primarily by fossil fuels and new cultural expectations about energy given the new possibilities mineral sources offered.³² Moreover, tapping the potential of the Susquehanna was only made possible thanks to vast sums of fossil fuels harnessed to dredge, divert, and dam the river.³³ Indeed, in his Conclusion, Jones declares that “one thing we must remember is that the organic energy regime has never gone away.”³⁴

Third, Jones highlights a “recurring pattern of the mineral energy regime: the use of mineral energy sources to solve problems created by the intensive use of mineral energy sources.” Fossil fuels made more powerful industrial machines possible. For example, “increased levels of friction could have provided a limiting constraint to growth. Petroleum-based lubricants addressed this concern thereby facilitating the construction of larger, faster, and more powerful industrial operations.” As Jones concludes, “lubricants sustained the synergistic relationships of the mineral energy regime” and thus “One energy transition begot another.”³⁵

In discussing both energy regimes, Jones draws on the material turn in the humanities and the more established attention to materiality within science studies to reveal how the physical properties of energy sources mattered to the development of energy systems and historical phenomena more broadly. In this sense, “organic” and “mineral” energy regimes do not adequately capture the particular qualities and characteristics that make a given form of energy valuable. Although scholarly and popular audiences tend to refer to “coal” and its importance to industrialization, Jones shows how coal was hardly monolithic. Anthracite coal burned differently than bituminous coal, but even anthracite coal varied. Crude oil was not homogeneous when it came out of the ground either, creating challenges for refiners.³⁶

By attending to the material properties of different energy sources, as well as the technologies that moved them, Jones demonstrates how “energy” is, in fact, a highly abstracted, generalized—not to mention commodified—term that obscures considerable differences among energy-rich substances. On the one hand, thinking about energy writ large can be useful, because it helps us, scholars and citizens alike, see how energy is a common basis of human societies and can thus facilitate comparisons and contrasts across history, culture, and environment. On the other hand, Jones shows how the physical characteristics of different energy forms matter, and too much emphasis on the meta-category of “energy” without attention to these material, historical, and other particularities can obscure fundamental differences among them.

³² Jones, 186 and 191.

³³ Jones, 173.

³⁴ Jones, 236.

³⁵ Jones, 91 and 115-116. See also 193 on electric streetcars as a solution to the growing distance of urban space.

³⁶ Jones, 34-37, 49, and 110-111.

The risk of abstraction—not only in the past but also in scholarly analysis—comes up in Jones’s brief discussion of slavery.³⁷ He brings up slavery to help explain why the mineral energy regime and energy intensification matter. Indeed, Jones’s conclusion to Chapter 2, which examines early coal usage, argues that the stakes of this trend go well beyond simply increased volumes of fossil fuels consumed. Quoting historian Thomas Cochran, Jones asserts that “anthracite coal helped give rise to ‘one great manufacturing complex from Wilmington to New York. From 1843 to 1860 this megalopolis was probably the most rapidly growing large industrial area in the world.’”³⁸ He continues, “The coal-fired growth of the mid-Atlantic set it apart from other parts of the nation. These regional divergences would soon take a momentous turn with the outbreak of the Civil War. Different energy endowments between North and South were one of the factors driving the conflict. Southern states relied on human labor, and their fear of losing that system contributed to their belief that secession was their only option.” Moreover, “This gap in energy practices was not as pronounced forty years earlier. In 1820, New England, the mid-Atlantic, and the South were all part of the organic energy regime.”³⁹ Ultimately Jones concludes that anthracite coal and the mineral energy regime more broadly shaped the outcome of the Civil War and the United States as a whole: “As in most wars throughout history, the side able to deploy more energy emerged triumphant. The pioneering of the mineral energy regime in the mid-Atlantic not only reshaped the region, it transformed the future of the nation.”⁴⁰

In these final sentences of the chapter, Jones raises big questions about agency and causality in environmental history—and other fields. I revisit these questions below, but I want to return here to the issue of slavery and how Jones discusses it. It is certainly historically and analytically useful to consider “energy endowments,” “energy practices,” and ways to “increase[e] energy availability,” as Jones does in his discussion of regional energy differences in the United States quoted above.⁴¹ As he notes, “[i]n such a world [of shared dependence on muscles, falling water, and

³⁷ To be clear, I am not a historian of the United States, the Atlantic World, or slavery. Nevertheless, I am aware of recent scholarship that makes slavery central to the history of capitalism. See Edward E. Baptist, *The Half Has Never Been Told: Slavery and the Making of American Capitalism* (New York: Basic Books, 2014); Sven Beckert, *Empire of Cotton: A Global History* (New York: Alfred A. Knopf, 2014). In addition, it’s important to acknowledge that Jones’s discussion is quite short (only two pages), and slavery is not the focal point of his book. The relative absence of slavery in a book on energy in nineteenth-century America can be partly explained by the geographical boundaries of his narrative: Jones focuses on the “mid-Atlantic,” by which he essentially means Pennsylvania with forays along the Atlantic coast south to Baltimore and north to New York City, with ventures inland to Cleveland. This spatial scope reflects the geographical borders of the energy transport networks Jones analyzes. One might ask how other spatial scales, ones that include other transport infrastructure of the era (the Erie Canal? the transcontinental railroads beyond the mid-Atlantic region?), might have (re)shaped Jones’s findings. The selection of geographical boundaries seems particularly significant, given the importance of slavery to the organic energy regime of the American South and debates over its extension into western states in the mid-nineteenth century.

³⁸ Jones, 85

³⁹ Jones, 86.

⁴⁰ Jones, 87.

⁴¹ Jones, 85-86.

plants], there were relatively few options for increasing energy availability. Slavery was one. Though slavery in the American South was particularly violent, brutal, and reprehensible, it was not an uncommon approach to labor shortages. Throughout world history, many societies in the organic energy regime have relied on variations of human bondage including slavery, *corvée* labor, and serfdom.”⁴² Clearly American slavery was not unique.

Yet I am uneasy—analytically, historiographically, and foremost politically—about framing slavery as an “energy practice” or way of “increasing energy availability.” My concern is that such frameworks risk dehumanizing, abstracting, and commodifying African-Americans, thereby perpetuating those very historical processes that justified slavery in the United States and elsewhere. To give one concrete example of this slippage between the historical and the analytical, in Jones’s short discussion of slavery, he writes that “By 1860, coal provided additional power to many in the mid-Atlantic, serving as what scholars have described as inanimate ‘energy slaves.’”⁴³ However, the “scholars” referenced here refer primarily to a late-nineteenth-century French demographer and economist. In the endnote, Jones explains that “The idea of energy slaves was introduced at least as early as 1880 by Emile Levasseur.”⁴⁴ Given this additional context, Levasseur should be treated as a primary—not secondary—source and “energy slaves” needs to be examined critically. Levasseur may have interpreted slavery through the lens of energy, and this interpretation particularly suits the writing of energy history, but the association is not innocent.

In developing the concepts of organic and mineral energy regimes, I wonder if Jones might have theorized the regime aspect of these analytic tools more and if such theorization might have simultaneously addressed my reservations about his discussion of slavery. For instance, given his engagement with the history of technology and STS, I could see Gabrielle Hecht’s technopolitical regime and Michelle Murphy’s regimes of (im)perceptibility helping advance the regime element of his concepts.⁴⁵ The metaphor of regime in Jones’s empirical context is intriguing, in part because it is so amenable to analysis of power relations that—as his work ably shows—both shape and are shaped by energy systems.⁴⁶ Overall, Jones’s mineral energy regime bolsters several insights from Hecht’s technopolitical regime: the ways that “technological” systems such as transport networks can foster,

⁴² Jones, 86.

⁴³ Jones, 86.

⁴⁴ Jones, 261, note 74.

⁴⁵ Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II*, 2nd ed. (Cambridge, MA: MIT Press, 2009); Michelle Murphy, *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers* (Durham: Duke University Press, 2006).

⁴⁶ I discuss co-production more below. As Hecht explains with respect to her concept of technopolitical regime, regime obviously connotes power and politics, but it also hints at resistance. The regime metaphor also suggests institutionalization, usually understood in political and bureaucratic terms; yet in this context (and drawing on Hecht’s broader notion of technopolitics), the metaphor can imply technological institutionalization as well.

(literally) fuel, and reinforce growing reliance on fossil fuels and thus the political and economic interests that benefit from such dependency. Indeed, one of Jones's vital lessons about energy transitions is the unequal distribution of costs and benefits associated with the mineral energy regime.⁴⁷ Although I would have liked to hear more of Jones's theoretical thinking here, I suspect he chose to downplay such discussions because he wanted the book to reach a broader audience, which is, of course, an important and laudable goal.

My discussion of the regime metaphor serves as a segue to Jones's third concept: "landscapes of intensification." This too is a rich concept, and I was compelled by Jones's argument regarding the mineral energy regime's "synergistic feedback loops."⁴⁸ Jones traces how capital investment in energy transport infrastructure such as railroads was a huge incentive for corporations to promote greater energy consumption—from expanded adoption in factories to urban streetcars and amusement parks to domestic appliances, to supposedly save labor.⁴⁹ At times, companies like Standard Oil temporarily subsidized transport costs in order to get a larger, long-term share of the market as demand rose.⁵⁰ As work, play, mobility, and daily life became increasingly permeated by new sources and quantities of energy, energy-intensive practices became normalized, even taken for granted.⁵¹ It was less clear what analytic work "landscapes" in landscapes of intensification performs. I believe Jones chose landscapes to stress the importance of energy-rich environments that had (already) been managed and harnessed by technical networks such as canals. In other words, "second nature" or envirotechnical preconditions made intensification possible.⁵²

The way Jones develops and mobilizes intensification in his analysis reflects his theoretical positioning within the history of technology and STS. As he notes in the Introduction, he draws on co-production to emphasize the ways that "Infrastructures ... are social as well as technological. Cultural values ... strongly influence which technologies get built and how they are used over time. Once put in place, technological transformations of the world feed back into social values. ... This is not a deterministic relationship, but rather one of mutual shaping: social and technological worlds are co-produced."⁵³ Jones's frequent usage of "positive feedback loops," "synergistic feedback cycle," and variations of these phrases seeks to offer a nondeterministic account of fossil fuel adoption, while nonetheless

⁴⁷ This important theme threads through the book. For just a few moments in which Jones discusses this issue, see Jones, 79-85, 116-120, and 233.

⁴⁸ For instance, on coal, see 60; on oil, see 112.

⁴⁹ Ruth Schwartz Cowan, *More Work for Mother: The Ironies of Household Technology from the Open Hearth to the Microwave* (New York: Basic Books, 1983).

⁵⁰ Jones, 106 and 134.

⁵¹ Jones, 1-2.

⁵² "Second nature" is from William Cronon, *Nature's Metropolis: Chicago and the Great West* (New York: W.W. Norton, 1991).

⁵³ Jones, 8. See also 13.

acknowledging the overall trend toward mineral energy.⁵⁴ Key to these feedback loops is the energy transport infrastructure he historicizes. Once built, canals, pipelines, railroads, and wires favored and reinforced the mineral energy regime. As Jones puts it, “Crucially, these transport networks were not passive conduits.”⁵⁵ Here he draws on conversations in technology studies that emphasize the tight relationship between technology and politics. Although he never uses the term, Jones convinced me that energy transport networks in the nineteenth-century mid-Atlantic were technopolitical.⁵⁶

However, elsewhere Jones makes much stronger claims about the determining role of energy and energy transport technologies in urbanization, industrialization, and American history. I have already cited his discussion of the US Civil War and the differential energy resources of the North and South. In other parts of the book, Jones argues for an examination of energy history to gain a better understanding of historical change. As Jones writes, “Canals, pipelines, and wires *created a world* in which increased energy consumption was both possible and desirable.”⁵⁷ For instance, “anthracite coal would *trigger* profound changes in the economy, environment, and society of the mid-Atlantic.”⁵⁸ Because it was “a cheap and abundant heating fuel requiring minimal land for its production, anthracite *enabled* the rapid growth of nineteenth-century cities.”⁵⁹ But it wasn’t just coal: “Whether for light, lubrication, heat, or power, petroleum *pushed* the nation further into the mineral energy regime.”⁶⁰ Put another way, Jones takes some of the main premises and insights of environmental history and extends them specifically to energy history. While both fields share an interest in nonhuman agency, energy history stresses the power, so to speak, of energy.⁶¹

Jones does an excellent job pushing all historians (not just environmental historians and historians of technology) to consider the vital role of fossil fuels in large-scale processes like industrialization and urbanization, but I am less convinced that it is *the* causal force, in part because arguments that tend towards monocausality are never entirely satisfying and tend to attract more criticism than constructive inquiry. Jones makes a persuasive case, for instance, that dense concentrations of energy and their transport infrastructure facilitated urbanization, but I couldn’t help but think

⁵⁴ For one example of a “synergistic” or “positive feedback loop,” “Anthracite, canals, and industrial cities grew together synergistically” (Jones, 85). For a few other examples, see 25, 60, 112, and 156.

⁵⁵ Jones, 57. See also 162 and 215.

⁵⁶ Langdon Winner, “Do Artifacts Have Politics?” *Daedalus*, 109:1 (1980): 121-136; Hecht, *Radiance of France*. The argument is also implicit in Jones’s title. For one extended illustration of the technopolitics of energy transport infrastructure, see Jones’s discussion of “Oil and the Gilded Age” (155-159). See also 57, 124, 141, 209, 215, and 217.

⁵⁷ Jones, 9. For other examples of this kind of argument, see “Transport improvements *drove* the energy transition to anthracite” (57) and “wherever its wires extended, electricity *left* few aspects of life untouched” (197). Italics added.

⁵⁸ Jones, 24. Italics added.

⁵⁹ Jones, 64. Italics added.

⁶⁰ Jones, 155. Italics added.

⁶¹ Jones, 234.

of other considerations: water infrastructure, capital, immigration. Furthermore, Bruno Latour, Timothy Mitchell, and others have demonstrated how entangled historical factors are, how complex “agency” is, and therefore the ways that “energy,” even as a supposedly natural object, cannot be neatly separated from political, cultural, and other factors.⁶²

In some places, then, Jones offers more contingent, co-productivist claims about the reinforcing, technopolitical tendencies of energy transport technology. In other places, he makes bolder assertions about its foundational role in the making of “modern America.”⁶³ I am not suggesting that Jones is an energy determinist; that would not accurately capture the historical and theoretical nuance of his book. But in *Routes of Power*, Jones does make both arguments and thus navigates structure and agency, contingency and power. This is, of course, a common challenge facing many scholars (historians and others), and Jones’s book speaks to the theoretical tightrope we walk.

In conclusion, Jones’s *Routes of Power* makes a significant contribution to our understanding of energy in modern America, as well as helping to foster growing scholarship in energy history. It will interest many environmental historians and historians of technology, among others. As the book was written for a wider audience, it is a good choice for classroom use and the wider public. Indeed, Jones’s commitment to engaging the latter audience is commendable. His book gives us an opportunity to think about how environmental historians, energy historians, and others could—and arguably should—participate in contemporary debates.⁶⁴ I thank Jones for writing an engaging book that invites deep conversation within academia—and beyond—about a pressing current issue, while also suggesting how insights from past energy transitions might inform current policy.

⁶² To provide one example, Jones discusses the War of 1812 and how the British cut off coal shipments to American ports. This spurred Philadelphia American craftsmen to seek more reliable coal supplies. Thus, coal may have fueled, even accelerated, early American industrialization, but the War of 1812 also incentivized the identification and tapping of domestic sources. This example suggests how blurry and entwined “environmental” and “political” factors are. See Jones, 33.

⁶³ See the subtitle of his book.

⁶⁴ Interview in Uri Berliner, “Even Pickaxes Couldn’t Stop the Nation’s First Oil Pipeline,” *All Things Considered*, National Public Radio, February 24, 2015, <http://www.npr.org/2015/02/24/388729919/even-pickaxes-couldnt-stop-the-nations-first-oil-pipeline>. See also Jones’s blog entries for the Huffington Post, <http://www.huffingtonpost.com/christopher-f-jones/>.

Response by Christopher F. Jones, Arizona State University

I'd like to begin by offering my heartfelt thanks to Stephanie LeMenager, Sarah Mittlefehldt, Gwen Ottinger, and Sara Pritchard for offering such perceptive and generous engagement with *Routes of Power*. Many acts of scholarship and writing are lonely; actually having a group of distinguished scholars discussing one's book and participating in a dialogue about it is a rare pleasure. Thanks as well go to Jacob Hamblin for editing, and more generally, for establishing such a distinct forum for environmental historians to discuss recent scholarship. I believe this marks the official end of his editorship (though I won't be surprised if he can't resist stepping in again from time to time), and the whole community has benefited enormously from his unpaid labors. Thank you, Jake, for all you have done.

Before responding to the numerous insightful comments from the reviewers, I'll open with some background into my motivations for writing this book. Given Stephanie LeMenager and Sara Pritchard's mentions of my social media inclinations, it will perhaps not be a surprise that I begin with Twitter. Scrolling through my feed earlier this summer, I came across a tweet that halted my rapid scan. On June 30, 2015, @Historianness wrote: "Reading @JoyceChaplin1's "The Other Revolution" in the Spring 2015 EAS. Makes awesome pt that Industrial Rev more consequential than Am Rev." My initial thought was, "obviously—doesn't everyone know this?" Sure, the American Revolution mattered greatly for the nation's development, but industrialization and its associated energy transitions influenced a much greater part of the globe and touched people's daily lives in much more concrete fashion. Chaplin states it better than I could: "It may seem heretical to make that claim, but too bad—I'm right. The development of fossil fuel economies has had far greater effect on the globe than did the creation of the United States."⁶⁵

My surprise, though, was quickly tempered as I remembered that what seems clear to a historian of energy and environment is not necessarily common nor sense for others. Later in her article, Chaplin argues that early Americanists have systematically under-examined the importance of the natural world and a similar claim could likely be made for most historical subfields as well. Such sentiments exist outside the academy as well, as evidenced by [Apple's recent \(and absurd\) claim](#) that its app store has been more innovative than the industrial revolution.

Complaining that others do not consider your topic as important as you do—while a time-honored academic tradition—is cheap and easy. Constructing a narrative that creates compelling connections between one's topic and what others care about is a different matter. Writing energy history in a way that could draw in others represented one of my primary challenges and motivations in writing *Routes of*

⁶⁵ Joyce E. Chaplin, "The Other Revolution," *Early American Studies* 13, no. 2 (2015): 286.

Power. Though I wished, of course, to create a book with relevance for scholars in the histories of energy, technology, and the environment, I asked myself repeatedly: “if someone does not care about energy, why should they care about this book?”

My succinct answer is that people should care because the transition from an organic to a mineral energy regime was a necessary (though not sufficient) condition for the sweeping set of transformations in American life between 1820 and 1930. Through the prolific consumption of energy stocks—often beginning in homes and spreading to factories and then the suburbs—Americans created an urban and industrial superpower that hardly resembled the nation of rural farmers at the time of independence. Burning coal instead of wood in stoves, therefore, was not a simple act of switching fuels: it was a crucial step in enabling the rise of large cities, which as urban historians have demonstrated, were sites of deep contestation over issues such as immigration, urban space, political corruption, and conflicting views of race, class, and gender. Similarly, the adoption of fuel-burning equipment in factories did not just change the ways people manufactured goods: instead, it enabled a broader shift to industrial modes of production that were accompanied by massive inequalities in wealth distribution, explosive conflicts between capital and labor, greater integration of most Americans into a national market economy, and new experiences of time and space that were an essential part of modernity. Indeed, I’d suggest such canonical events in American history including the excesses of the Gilded Age and the reform efforts of the Progressive Era can be seen, in certain ways, as social responses to a world recreated through new energy practices.

This is not, of course, to offer a reductionist view of American social and political development. Energy did not determine either the problems Americans faced or the solutions that they offered; a vast range of other forces and challenges confronted Americans at this time. Nor, for that matter, does *Routes of Power* offer the same level of sustained effort to integrate the natural world into mainstream history as seen in Mark Fiege’s *Republic of Nature*. Yet what I did hope to accomplish was to write history in a way that would cause scholars such as @Historianness to be less surprised when considering the role of energy in human development.

I offer these comments in part to provide background for the book and in part to articulate a hope for the young and burgeoning field of energy history. For energy historians—and those in the energy humanities more broadly—these are heady times. Interest in the field has grown enormously over the last decade, with energy representing a growing share of panels at ASEH and other conferences. Indeed, expansion has been so rapid that it is beginning to make sense to talk about whether energy history can constitute its own field replete with a professional society, annual conference, and flagship journal.

Growth is a double-edged sword. On the one hand, it produces opportunities for scholars to examine many topics of energy history that have been under-analyzed. On the other hand, my fear is that such growth will create the temptation for scholars within the field to talk mainly to one another and downplay other

audiences. This, I believe, would be unfortunate. Energy is—and always has been—central to the human experience, but this perspective will only spread beyond the field if those of us who are practitioners consistently make such a case. At present, I am thrilled to be part of a community where so many others are pushing the bounds of energy history and its relation to other fields: in the same year *Routes of Power* was published, at least three other books (and I'm sure I'm forgetting more) by Robert Johnson, Robert Lifset, and Andrew Needham appeared that achieved similar ends in American energy history.⁶⁶ But as the field matures, it may actually become a greater challenge to maintain this effort to make broader connections if our internal audience is larger. So I urge the field to keep in mind the extensive groups of historians and other scholars who will not attend our conferences or be a direct part of our conversations. I hope we will continue to write works that make Joyce Chaplin's claims seem banal rather than heretical.

Let me turn to the reviewer comments. The panel raises a number of excellent points, a number of which make me hope there will some day be a second edition of the book so that I can do proper justice to them. While each scholar took a distinct approach, a number of cross-cutting themes emerged. These include questions of theory and agency, slavery, and optimism versus pessimism, each of which I'll address in turn after briefly respond to a few of the more specific points made by the authors. Stephanie LeMenager notes that I write for public audiences but chose to use a more formal tone for the book. This is true, and reflects what I consider to be a wonderful dimension of scholarly life: we operate in multiple genres and can alter our tone, content, and style accordingly. I picked the tone that I thought most appropriate for the book, and have enjoyed striking a more conversational approach in several short pieces since its publication, which can be seen [here](#), [here](#), or [here](#). Sarah Mittlefehldt points out that it would have been beneficial to strengthen the evidence I provide about sacrifice zones, and in particular, to provide more social history about who suffered, in what ways, and what times. I fully agree—this is a great insight and a topic that merited more attention. I recognize a tendency in my own scholarship to tend toward abstraction and this is certainly a case where more concrete detail would have helped.

Theory & Agency

Sara Pritchard raised the issue of theory and correctly notes that I downplayed such discussions to keep the text accessible. In my quest to make the book relevant to those outside the historical and social studies of energy, technology, and the

⁶⁶ Were this list to be expanded to include non-American works, those by non-historians, and those published in other years, it would be much, much longer and include titles such as Stephanie LeMenager's *Living Oil* and the *Energy Capitals* volume edited by Joe Pratt, Martin Melosi and Kathleen Brosnan. Bob Johnson, *Carbon Nation: Fossil Fuels in the Making of American Culture*, Cultureamerica (Lawrence, Kansas: University Press of Kansas, 2014); Robert Lifset, *Power on the Hudson: Storm King Mountain and the Emergence of Modern American Environmentalism*, History of the Urban Environment (Pittsburgh: University of Pittsburgh Press, 2014); Andrew Needham, *Power Lines: Phoenix and the Making of the Modern Southwest* (Princeton: Princeton University Press, 2014).

environment, I felt explicit theoretical discussion risked obfuscation rather than clarification. But as this forum provides an ideal setting for further elaboration of theoretical foundations, I'm delighted to discuss the topic more here.

This project began squarely as a work in the history of technology. My initial fascination with the topic started with oil pipelines and their role in shaping social outcomes. In fact, I can still remember my inspiration: on page 44 of Daniel Yergin's *The Prize*, he includes a map on of the Tide-Water pipeline with the provocative title "The Independents Break Out."⁶⁷ His discussion ran less than a page, and left me wanting to know more. As a graduate student in the department of Thomas Hughes, it should come as no surprise that SCOT (social construction of technological systems) and Hughesian systems thinking framed my initial thinking on the topic.⁶⁸ As I dove into research, I investigated questions such as: "Who built pipelines?" "Where were they located?" "Where were they not located?" "What labor was required to construct them?" "Who profited?" and "What environmental consequences did they have?"

Soon, however, I realized that these questions, and SCOT more generally, could only take me so far. Canals, pipelines, and wires were surely socially constructed, but this did not help me analyze in what ways the world became a different place once they were in operation. For this question, I found the framework of co-production to be my most useful ally.⁶⁹ Co-production encourages attention to the mutually constitutive shaping and reshaping of our social, epistemological, and material worlds. In my project, it helped me focus attention on the dynamic interplay between why people thought building energy infrastructures was a good idea; how these systems encouraged, funneled, and constrained energy flows once built; and changes in social life as people began to adopt new energy sources in prodigious quantities. Had I been inclined to write this book foregrounding theory, I would have invoked the language of co-production much more repeatedly. As it was, I found integrating the concepts of organic and mineral energy regimes to help capture the important changes over time in a way that I hoped balanced the goal for generalization without sacrificing accessibility to wide audiences.

Could I have accomplished similar ends with a framework such as technopolitics or regimes of perceptibility? Perhaps. I'm not well-versed with the concept of regimes

⁶⁷ Daniel Yergin, *The Prize: The Epic Quest for Oil, Money, and Power* (New York: Simon & Schuster, 1991), 44.

⁶⁸ I completed graduate training at the History & Sociology of Science Department at the University of Pennsylvania. Hughes had long been retired, though he was a generous enough scholar that he agreed to discuss the topic with me at an early date and offer encouragement. Ruth Schwartz Cowan served as a wonderful advisor for this project and I received invaluable assistance from Robert Kohler and Walter Licht as committee members and John McNeill as an outside reader.

⁶⁹ Personal history no doubt shaped this development as well; after graduating from Penn I had the good fortune to complete a postdoc with Sheila Jasanoff and my extensive conversations with her shaped the book's direction considerably. Sheila Jasanoff, *States of Knowledge: The Co-Production of Science and Social Order* (London; New York: Routledge, 2004).

of perceptibility, but I've long been familiar with the idea of technopolitics, and it certainly helped frame my thinking. Throughout the book, there is a great deal of attention to the interrelationships between technology and politics, and I'm sure that having read works by Gabrielle Hecht and others influenced my analysis. So the big question becomes: would explicitly foregrounding technopolitics have allowed me to make different or more powerful claims? Here I expect that the answer to this question is one of taste: for those inclined to theoretical accounts, the answer would likely be yes. But for those treating theory as a means to an end and favoring empirical case studies that reveal dynamics of power and inequality, the answer is likely no. I fall into the latter camp. When researching *Routes of Power*, I was most excited at those moments I found empirical evidence that illustrated unexpected dynamics of energy transitions (such as the pervasive pattern of supply driving demand, rather than the converse) or documented patterns of unequal access to new energy sources (such as analyzing coal flows to determine where it went as well as where it did not). When I had evidence of this sort, I did not feel greater theoretical framing would enhance the argument.

At least one other theoretical construct shaped my thinking without making an appearance in the book: actor-network theory. And this helps explain some of my views on determinism and agency of non-human actors. Though non-human actors certainly do not possess intentionality in the same way humans do, I am very comfortable with the idea they can shape and constrain human actions, which I consider to be synonymous with having a form of agency. And therefore while a great deal of *Routes of Power* emphasizes the contingencies of infrastructure construction and energy transitions, it does recognize that certain feedback loops consisting of consumer behavior, infrastructure logics, and financial incentives (what I call "landscapes of intensification") obtain powerful momentum over time. And so in the points of the narrative where I felt I had sufficiently demonstrated the contingent creation of these landscapes of intensification, I did not have a problem making claims about energy or canals "creating" or "enabling" social change. Taken out of context, such statements would be problematic for all the well-known limitations of deterministic arguments. And in earlier drafts of the manuscript, most of these statements were hedged with qualifiers such as "once socially constructed, canals ..." or "contingent in its adoption, oil eventually..." However, as I edited the manuscript, I began to find the incessant use of such caveats overly cumbersome. At the risk of appearing deterministic in some places, I preferred the cleaner text that resulted once the endless stream of hedging statements lay on the cutting room floor.

Slavery

Both Stephanie LeMenager and Sara Pritchard caught my brief reference to slavery, and Sara Pritchard in particular wants to know more about the subject. To be clear, I will emphasize (as Sara Pritchard kindly acknowledges) that this was a passing point upon which I hung little analytical weight. Since I wanted to integrate the story of energy into American history more generally, I certainly did not want to let major

events such as slavery and the Civil War pass unmentioned. That being said, it was beyond the purview of a book exploring the mid-Atlantic region to make more than an offhand suggestion of ways that slavery and energy might be interrelated. My remarks were intended to be suggestive, not to offer anything approximating an in-depth analysis of the issues.

Yet I agree the topic deserves more attention. And had I written this book two years later, I may have chosen to do so. The time is right, I believe, for some very innovative work to be done on energy and slavery, and I hope these comments will encourage some to take up the topic. My new research is taking me to different regions and time periods—energy, capitalism, and theories of growth in the 20th century—but if anyone (aspiring graduate students especially) is looking around for fruitful areas for study, I suggest considering the energy-slavery nexus.

What has changed in the last few years? The study of slavery and capitalism has become a dynamic hotbed of interesting research. Previously, most historians had treated slavery as a backward and non-capitalist economic system. But as new works by Walter Johnson, Sven Beckert, Caitlin Rosenthal, and Calvin Schermerhorn have made clear, slavery was central to the development of capitalism.⁷⁰ Slave markets, slave-backed financial instruments, and plantation accounting systems all reveal that southerners were deeply embedded in capitalist systems and, in many cases, more adept at maneuvering in a capitalist economy than northerners. In short, they have taken a field that many thought had little to do with each other—slavery and capitalism—and demonstrated central linkages.

Could the same thing be done with energy and slavery? My hunch is that it can. Building on the new insights about slavery and capitalism, I expect the introduction of energy could lead to compelling new work. Doing so, however, will likely require moving past what can be seen as two ways of looking at the connections between energy and slavery. The first, associated with Robert Fogel's *Time on the Cross*, reduced slavery simply to an economic matter of labor productivity.⁷¹ Though incredibly detailed about the economic inputs and outputs of plantation agriculture, the book provoked a firestorm of criticism for largely ignoring the appalling conditions under which slaves worked. As Sara Pritchard rightly notes in her review, such abstraction from the brutalities of slavery is deeply problematic.

The second strain of scholarship, referenced by Stephanie LeMenager in her review (and that I cite in *Routes of Power*) is more recent. It is much more compelling, I think, though likely offers room for revisions. Drawing on observations by John McNeill regarding slavery as a characteristic feature of pre-fossil fuel societies and

⁷⁰ Walter Johnson, *River of Dark Dreams: Slavery and Empire in the Cotton Kingdom* (Cambridge, Mass: Harvard University Press, 2013); Sven Beckert, *Empire of Cotton: A Global History* (New York: Alfred A. Knopf, 2014); Calvin Schermerhorn, *The Business of Slavery and the Rise of American Capitalism, 1815-1860* (New Haven: Yale University Press, 2015); Caitlin Rosenthal, *From Slavery to Scientific Management* (manuscript under contract with Harvard University Press).

⁷¹ Robert Fogel and Stanley Engerman, *Time on the Cross* (W. W. Norton & Company, 1974).

further extended by Jean-François Mouhot in a 2011 article, this approach emphasizes long-term comparative analysis of energy systems.⁷² It instructively rejects the idea that energy history begins with fossil fuels, instead seeking to understand similarities and differences between organic and mineral energy regimes. Scholars in this approach often invoke the concept of “energy slaves” to provide comparisons between contemporary and historical energy practices. An “energy slave” in this context is usually defined to be the energy output of an average human worker. In this sense, it is a technical definition comparable to other energy measures such as horsepower—a standard that also originated with animal power and is unobjectionably translated to mechanical engines. One can count up all the sources of energy used by an average person—home heating and cooling, transportation, food, electrical devices, etc.—convert it to a standard measure, and divide by the energy output of the average human to determine one’s number of energy slaves—[often estimated](#) at anywhere from 80 to 150 for contemporary Americans.

This approach to energy and slavery exhibits both optimistic and pessimism. Such scholars are frequently optimistic insofar as they suggest that historically, mechanical energy can be a direct replacement for human slavery. On the other hand, they are cautious in noting how deeply energy is permeated into our daily existence and are often therefore pessimistic about whether people will give up such clear personal benefits voluntarily. Moreover, without denying the evils of slavery, such scholars are concerned that the moral harms of intensive fossil fuel consumption frequently get underestimated, such as the wars fought to preserve favorable access to oil, the local harms to communities near sites of fossil fuel extraction and processing, and the anticipated consequences of climate change in the global South.

The phrase “energy slave” is, of course, not merely a technical description akin to horsepower. Using the loaded terminology of slavery is clearly intended to provoke a strong response. No one gets offended by the idea that contemporary Americans have access to the power of 200 horses when they drive their car, but it is a different matter to declare that Americans regularly avail themselves of a hundred energy slaves. As Sara Pritchard notes, the expression is jarring and appears on first blush to offer the same insensitive abstracting of human bondage that was so widely criticized in Fogel’s work. Used with full acknowledgement of this combination of technical and political meaning (technopolitics!), I have found the concept to be powerful, particularly when trying to get students to move past discussions of kilowatt-hours and into the moral meanings associated with energy consumption. However, used uncritically, it is clear that the concept can be a significant liability. As a result, one opportunity for new directions in the history of energy and slavery

⁷² John Robert McNeill, *Something New under the Sun: An Environmental History of the Twentieth-Century World*, 1st ed. (New York: W.W. Norton, 2000), 10-16; Jean-François Mouhot, “Past Connections and Present Similarities in Slave Ownership and Fossil Fuel Usage,” *Climatic Change* 105 (2011).

is to examine this concept in greater depth to assess its strengths and weaknesses and situate it within its historical evolution.

A second opportunity for revisions within this approach to energy and slavery concerns the question of optimism. I wonder whether the story of the replacement of human slaves by mechanical devices is too neat and clean. And to be fair, Mouhot in his article clarifies that in many cases, mechanical devices for industrial production actually increased the demand for slavery, so he is certainly not offering a linear story of progress. More attention to the interconnections between increased demand for fossil fuels and the increased demand for slavery strikes me as an important story to tell. Third, more comparative analysis can be helpful. Often the history of American slavery is written without a great deal of comparison to other forms of human bondage, and understanding what was similar and different in the energy-slavery nexus in America versus other times and places could be a promising path forward.

In sum, then, I believe we are at an opportune time for really interesting work to be done on energy and slavery and I hope others take up the challenge!

Optimism, Pessimism, and the Present

Sarah Mittlefehldt praises *Routes of Power* for offering students a sense of optimism that alternative energy patterns can be created, particularly if one takes seriously the historical finding that supply has driven demand. Gwen Ottinger takes the opposite tack, wondering if I am overly sanguine about the prospects for a more just and environmentally-friendly energy future, particularly given that *Routes of Power* spends so much time analyzing the momentum of the mineral energy regime. I find both their remarks entirely persuasive, and they capture a central tension I felt as I researched and wrote the book. Am I, at the end of the day, an optimist or a pessimist? It depends, in short, on the day.

I'll confess that I spend a good deal of my time in Gwen Ottinger's camp. She does a particularly eloquent job of laying out the reasons for pessimism implicit in *Routes of Power* including the ways energy infrastructures overlap and reinforce one another, the negative consequences of centralization for environmental justice, and the groups of powerful capitalists who have grown rich on fossil fuels and will fight tooth and nail to preserve their privileged positions. Decreasing fossil fuel usage when there are such strong infrastructural and financial incentives to increase consumption will be challenging, to say the least. Moreover, these factors suggest that even if we add a significant capacity of renewable energy, it may perpetuate some of the same inequalities of the fossil fuel system. As I show in the book, hydroelectric dams share numerous characteristics with coal mines and oil wells: all concentrate economic harm in rural areas to ship the benefits of cheap and abundant power to consumers located elsewhere. Even though they do not involve fossil fuels, large wind farms and desert solar arrays appear poised to repeat these unequal patterns. Turning Arizona's deserts into energy hinterlands for Phoenix and

Los Angeles or using the Great Plains to send power to Chicago will require massive disruptions to landscapes, organizations controlling billions of dollars, and unjust distributions of costs and benefits. The power may be more sustainable, but such a transition would leave much to be desired in terms of its human outcomes. Add to this the present dysfunction of American politics and it is tempting to slide into resigned defeat.

Despite being well aware of these arguments, I ultimately struck a more optimistic tone in the book. I did so for reasons both historical and contemporary. One of the most striking findings from my research involved the extent to which the rate and extent of past energy transitions exceeded the imaginations of their pioneers. When historical actors made projections for consumption, they consistently underestimated the potential markets (even as they worked feverishly to build them). For example, the directors of the Schuylkill Canal in 1817 only anticipated about 10,000 tons of coal being shipped along a network that two decades later was delivering hundreds of thousands of tons annually. Similarly, Josiah White designed a canal system in 1827 for the Lehigh Valley that he proudly announced could handle two and a half million tons a year; within a few decades coal shipments from the region eclipsed that amount. Even the shrewd John D. Rockefeller lived in a world where kerosene represented the primary market for oil; envisioning the explosive growth in gasoline consumption after 1910 would have seemed laughable in 1890. Those in the past read the conditions of the present into their imaginations for the future and did not see the likelihood of significant change; if history is any guide to current times, I believe one of its lessons is that we risk doing the same.

Moreover, substantial evidence from contemporary events suggest that while the current system has considerable momentum, it can be shaken up and redirected. Any intelligent observer of contemporary energy systems writing in 2005 would have been justified in treating hydraulic fracturing as a fringe technology unlikely to make a major difference; it turns out, of course, that fracking has revolutionized energy markets over the last decade. While the history of solar power has often been one of hype exceeding reality, reductions in the costs of photovoltaic panels over the last five years have led to enormous increases in solar installations. Wind power, [according to the Energy Information Administration](#), is now cheaper to install than coal or even natural gas. Of equal importance, consciousness of the need for energy transitions is higher than ever, with even a majority of self-described conservative Republican voters [supporting action](#) to mitigate climate change.

All of this suggests to me the value of cautious optimism. I do not expect that fossil fuel companies will vanish into the background, but I do think that with a suitable price on carbon, they can achieve profits while funding climate mitigation strategies and investments in renewables. I do not expect a renewable energy transition to create the world of “small is beautiful” that was hoped for by advocates in the 1970s, but that does not mean even concentrated and heavily capitalized renewable energy cannot offer some improvements to the system. Moreover, policies that encourage rooftop solar rather than utility-scale plants can partially offset the geographic

separation of energy production from consumption. Change will be challenging and it will be contested, as is clearly demonstrated by utilities vigorously fighting rooftop solar net metering policies. But I consider it a fair reading of the past to argue that one does not have to be hopelessly naïve to consider a better energy future possible and worth fighting for. The world may not be as malleable as renewable energy's most ardent advocates hope, but history suggests it is not as firmly entrenched as we may fear.

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