INTRODUCTION

TOWARD A NEW ENERGY HISTORY

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IN 1973 THE ITALIAN NUCLEAR PHYSICIST CESARE MARCHETTI BEGAN FORmulating a "simple and predictive model describing energy markets for the last century." Four years later he produced one of the most iconic pictures in energy history: a schematic graph depicting energy systems rising and falling like clockwork over time. The age of wood replaced by the age of coal, then oil, then natural gas, and then, so he predicted, nuclear energy and solar power. "It is as though the system," Marchetti reflected, "had a schedule, a will, and a clock." All it took was time, and the right price. His imagery of regular transitions, unfolding smoothly without interruption, free from outside forces like politics or values, gripped experts around the world as they strove to change their nation's energy systems following the oil shock of 1973. Marchetti was working for the International Institute for Applied Systems Analysis (IIASA) in Austria, a think tank founded to bridge the Cold War divide with cutting-edge models for global problems. IIASA's ideas spread through Western Europe, North America, and the Eastern Bloc, and graphs strikingly similar in their assumptions informed policy across the Global North during the 1970s.[1]

A generation later, as global temperatures rise, sparking our glaciers to melt and our forests to burn, humanity stands before what could be the greatest collective challenge in history. In many respects, experts and politicians

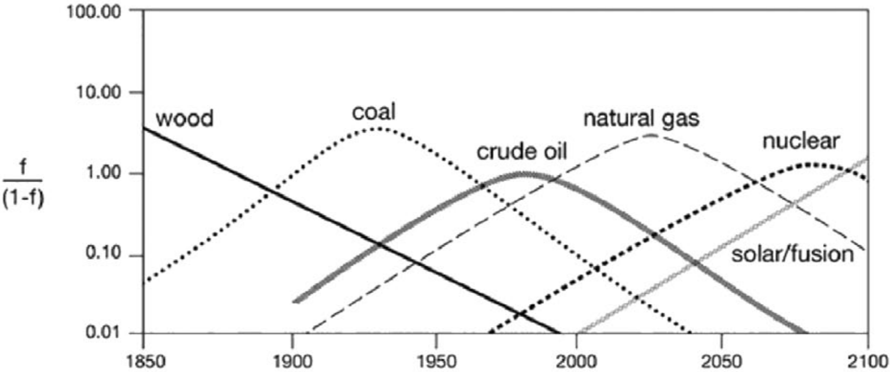

FIGURE I.1: Cesare Marchetti's model "Historical Evolution of the Primary Energy Mix for the World." 1850–2100. *f* = market fraction of an energy. *Source*: Cleaned image of Marchetti's diagram from Vaclav Smil, *Energy Transitions: Global and National Perspectives* (Santa Barbara, CA: Praeger, 2017), 84.

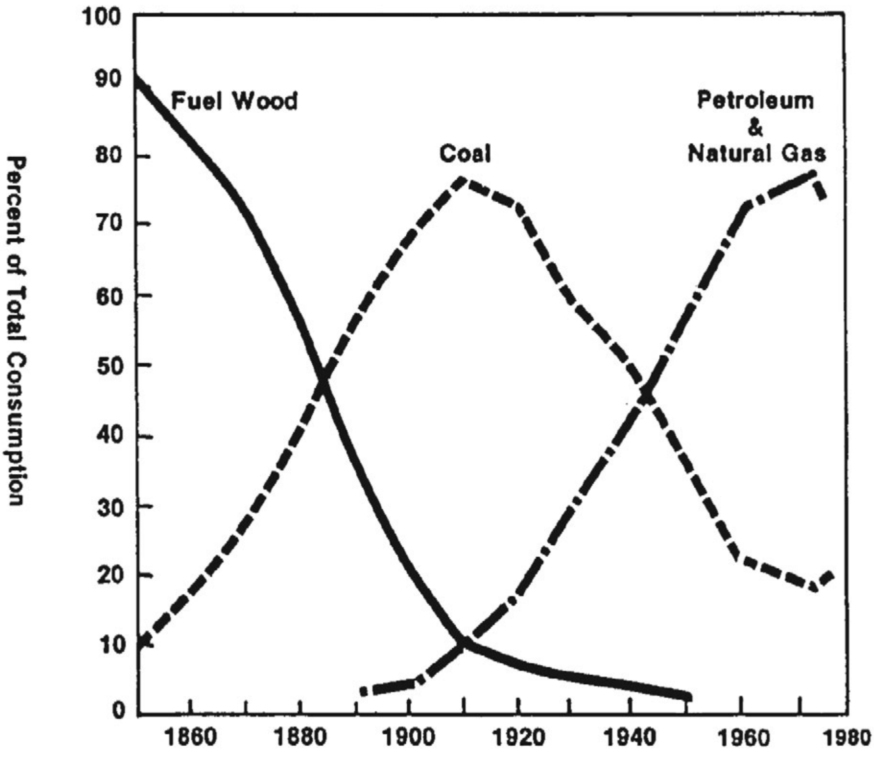

FIGURE I.2: Historical fuel shifts according to President Jimmy Carter's 1977 National Energy Plan. 1860–1980. *Source*: Frank Laird, *Solar Energy, Technology Policy and Institutional Values* (New York: Cambridge University Press, 2001), 114.

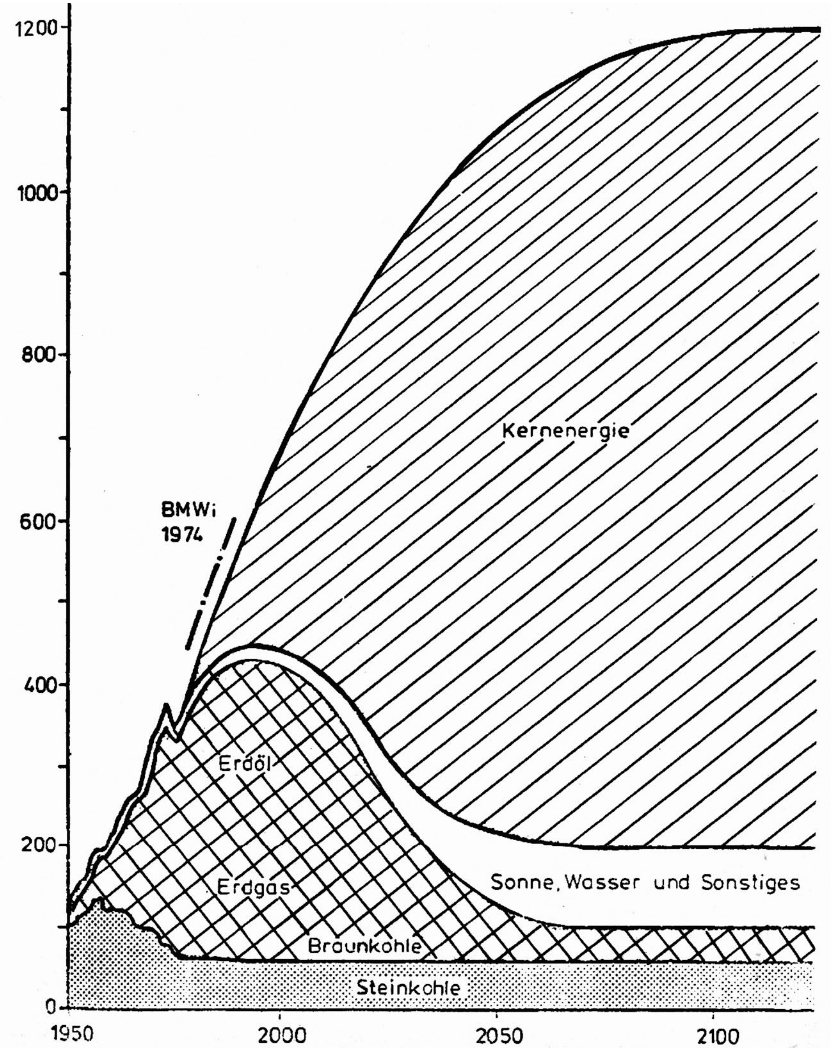

FIGURE I.3: First scenario forecast for West Germany's primary energy consumption, in the Social Democratic Party's Energy Forum of 1977. 1950–2100. Million tons of hard coal equivalent. *Kernenergie* = nuclear power; *Sonne, Wasser und Sonstiges* = sun, water, and miscellaneous; *Erdöl* = oil; *Erdgas* = natural gas; *Braunkohle* = lignite coal; *Steinkohle* = hard coal. *Source*: SPD, *Energie: Leitfaden zur Diskussion* (Bonn: SPD, 1977), 52.

are approaching global warming with historical assumptions about energy that have changed little since the 1970s. One hopes for a transition toward renewable sources of power like the sun and the wind. But the models informing public debate today—whether historical, digital, or cognitive—bear an eerie resemblance to earlier ones. In his famous appeal to repower the United States in 2008, former vice president Al Gore claimed the United States could adopt a carbon-free electricity network within decades. A year later Mark Jacobson and Mark Delucchi, engineers writing in *Scientific American*, suggested the world could achieve 100 percent renewable energy in twenty years. Ten years on they remained firm in their timeline, illustrating it with smooth curves of rising renewables and falling fossil fuels.[2] Many advocates of solar and wind claim this transition not only "mirrors" previous ones, but that the move from "fossil fuels to renewables has become inevitable" as costs fall. As Bruce Usher puts it, "Basic economic principles, primarily cost, are the main drivers of energy transitions. Cost is key."[3]

This narrative of grand sweeping curves, where transitions are defined by efficiency and price, is comforting: if only we can lower the cost of solar or wind, we can solve global warming. Or at least be on our way. But energy shifts are far more complex, far more human, and in fact far more interesting than lines on a graph, efficiency ratios, or prices. Historians have unearthed this complexity; they have a long tradition of studying the human side of energy in its many facets, even if histories of energy have often been fragmented into different wings of the discipline, from environmental history to the history of technology or diplomacy.[4] Despite this fragmentation, three points stand out in more nuanced histories of energy: (1) commercializing a new energy infrastructure involves protracted processes of political and economic change, (2) new energies almost never wholly replace old ones, and (3) the causes and effects of transitions reach far and wide, changing people's lives in unexpected and profound ways.

Since roughly 2010, diverse strands of historical study have been coalescing into a new field of energy history, a coalescence that motivated this volume. The chapters here explore the causes, courses, effects, and aftershocks of energy transitions in North America and Europe during the twentieth century. They not only historicize popular and economic notions of energy but also show how energy has reshaped everything from social life and economic organization to political governance. The volume draws on a range of historical approaches—including intellectual and cultural history, labor history, and political economy—to understand why some energy systems flourish while others do not, and to capture the cultural, intellectual, and political implications of new energy systems as they struggle to take shape. Over the past 250 years, energy transitions have occurred at a seemingly relentless pace—the rise of coal in the nineteenth century, the explosion of oil in the twentieth century, the nuclear utopianism of the 1950s and 1960s, and today the expansion of renewable power. These transitions have been as revolutionary as any

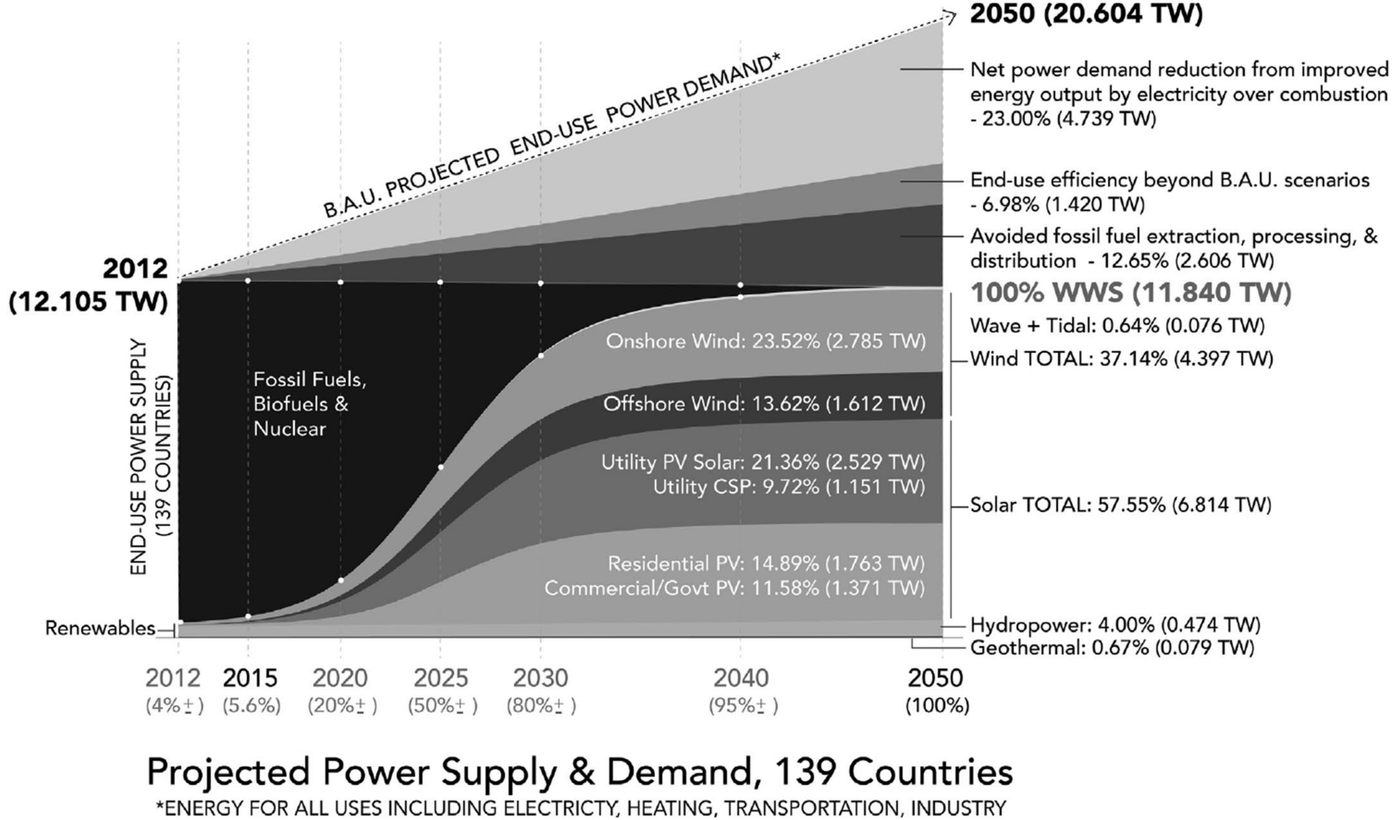

FIGURE I.4: "Projected Power Supply & Demand, 139 Countries." From Mark Z. Jacobson et al.'s "100 Percent Renewable Energy Roadmap for the World, 2017." 2012–2050. *Source*: Mark Z. Jacobson et al., "100% Clean and Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World," *Joule* 1 (September 2017): 118.

political or economic upheaval, but they have rarely featured in the grand narratives of twentieth-century Europe and North America.[5] Given the urgency of global warming, historians have a twofold task, which we hope to advance with this volume. We must do more to integrate a history of energy transitions into broader narratives of political, economic, or cultural change. And we must do more to bring our knowledge of the complexity and humanity of energy to the current debate—shaped in large part by economists, engineers, and scientists—over what could be the most monumental energy transition ever: the shift away from fossil fuels. In doing so, we aim to steer the public away from, on the one hand, doom-saying narratives of the impossibility of meaningful transition and, on the other, stories of revolutionary technological fixes driven by heroic individual entrepreneurs. Only by attending to the socially complex and technologically messy histories of energy transitions as they occurred can we provide a past usable for the present moment.

WHY ENERGY NOW?

Since the turn of the twenty-first century, global warming has emerged as the world's most pressing challenge. This wicked problem has led scholars to craft not only a new geological label but also a new category of analysis, the "Anthropocene," a concept coined in 2000 by Paul Crutzen and Eugene Stoermer to describe how humans are becoming a force of nature in their ability to alter the environment. While there was a delay between the uptake of this term by the natural sciences and the humanities, with the publication of Dipesh Chakrabarty's "The Climate of History" in 2010, the Anthropocene as a historical concept arrived. Chakrabarty's work sparked a debate about the origins of the Anthropocene, with starting points ranging from humanity's very nature as an extinctive species, to the Agricultural Revolution or Industrial Revolution, to the advent of the atomic age.[6]

Embedded within this debate are fundamental questions about how to understand human-driven environmental transformations. Historians have a rich tradition of studying the environment. Until recently, however, energy existed at the relative margins of environmental history, often surpassed in importance by themes such as wilderness management, agriculture, urbanization, water use, and forestry.[7] The urgency of the Anthropocene, however, has foregrounded the study of energy. For if the Anthropocene elevated global warming as *the* challenge of our century, it also illustrated the importance of studying fossil fuel energy systems, because these have accounted for 70 percent of all of the carbon humanity has emitted since 1870. At the heart of environmental degradation and climate change is the extraction, distribution, and consumption of energy.[8]