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The Culture and Politics of Energy in Germany

A Historical Perspective

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About the Author

David Blackbourn has been Cornelius Vanderbilt Distinguished Professor of History at Vanderbilt University since 2012. Before that he taught for twenty years at Harvard University, where he was Coolidge Professor of History, and for sixteen years at London University. Educated at Cambridge, where he was a research fellow, he has held fellowships from the Alexander von Humboldt Foundation, the DAAD, and the Guggenheim Foundation, and been Visiting Kratter Professor at Stanford University. He is a fellow of the American Academy of Arts and Sciences, a corresponding fellow of the British Academy, and serves on the editorial board of Past and Present and the academic advisory boards of the Lichtenbergkolleg, Göttingen University and the German Historical Institute, Washington, DC. He is also president of the Friends of the German Historical Institute.

His books include *Class, Religion and Local Politics in Wilhelmine Germany* (1980), *The Peculiarities of German History* (with Geoff Eley, 1984), *Populists and Patricians* (1987), *Marpingen: Apparitions of the Virgin Mary in Bismarckian Germany* (1993), *The Long Nineteenth Century: A History of Germany, 1780–1914* (1997), and *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany* (2006), which won the George Mosse Prize of the American Historical Association and the Charles A. Weyerhaeuser Prize for the Best Book in Forest and Conservation History, and was named Best Book in European History on H-Soz-und-Kult. David Blackbourn has lectured widely in Europe and North America on environmental history. He is now writing a book on "Germany in the World, 1500–2000."

This essay is based on a talk given by David Blackbourn at the Rachel Carson Center on 26 May 2011.

The Culture and Politics of Energy in Germany: A Historical Perspective

The American geographer Cutler J. Cleveland has written that "human history can be told in terms of the history of energy."[1] He ranges over the whole of that history, starting with the discovery of fire and the domestication of animals. It is useful to have our often present-minded perspective on energy challenged in this way. The idea of energy can indeed be broadened in other ways. The calorific energy provided by plants or animals is essential to human life. How (and whether) people in the past have satisfied this basic need tells us much about the workings of power in a given society. This is something we are increasingly being asked to reflect on by the new historical literature on food (and famine).[2] Cultural historians have also shown us how, around 1900, a scientific discourse emerged that cast the human body itself as a kind of energy machine—a human motor.[3] Sometimes these concepts of energy have been brought together. One of the outstanding environmental historians of our time, Richard White, made energy a central category in his book about the Columbia River, *The Organic Machine*. As he wrote there: "I emphasize energy because energy is such a protean and useful concept. The flow of the river is energy, so is the electricity that comes from the dams that block that flow. Human labor is energy; so are the calories stored as fat by salmon for their journey upstream."[4] My purpose in the present paper is much more modest. I am concerned with energy in the more conventional and narrow sense, a subject that has also taken off recently as a sub-branch of history. Works by the environmental historian Alfred Crosby and the historian of technology David Nye can stand as examples of the burgeoning genre of energy history.[5] I nonetheless hope to show that it is possible to join the material and cultural histories of energy.

This is a revised version of a paper delivered at the Rachel Carson Center on 26 May 2011, and before that at a conference on energy, the third in The Future of Science series organized by the Fondazione Umberto Veronesi and held in Venice 19–22 September 2007. All translations from German-language sources are my own, unless otherwise noted.

1 Cutler J. Cleveland, "Editor's Preface," in *Concise Encyclopedia of the History of Energy*, ed. Cutler J. Cleveland (Amsterdam: Elsevier, 2009), vii.
2 A good recent example is Alexander Nützenadel and Frank Trentmann, eds., *Food and Globalization: Consumption, Markets and Politics in the Modern World* (Oxford and New York: Berg, 2008). On famine, see Mike Davis, *Late Victorian Holocausts* (London: Verso, 2000), and James Vernon, *Hunger: A Modern History* (Cambridge, Mass.: Harvard University Press, 2007).
3 Anson Rabinbach, *The Human Motor: Energy, Fatigue, and the Origins of Modernity* (Berkeley, CA: California University Press, 1992).
4 Richard White, *The Organic Machine: The Remaking of the Columbia River* (New York: Hill and Wang, 1995), ix.
5 Alfred J. Crosby, *Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy* (New York: Norton, 2006); David E. Nye, *Consuming Power: A Social History of American Energies* (Cambridge, Mass.: MIT Press, 1998).

This essay began life at a conference on science and the future of energy. I was the only historian present. Historians are usually shy about addressing the future; the only thing we are good at predicting is the past. But in the case of energy, as of other key environmental issues like water resources, we can learn from the longer historical time frame. When the *New York Times* journalist Thomas Friedman wrote his book in praise of globalization, *The World is Flat*, my reaction was: no, it is Thomas Friedman's sense of the past that is flat, which distorts his understanding of both present and future.[6] What I hope to do is to deepen the understanding of present-day choices and debates about energy in Germany by showing how these emerged, suggesting parallels in the past, and pointing out the political and cultural as well as economic contexts of German energy regimes over the last two hundred years.

Let me start with some obvious points about the present. First, Germany is a member of the European Union, so energy policy is determined within broad EU guidelines—although Germany, along with smaller countries like the Netherlands and Denmark, has also been a pacesetter within the EU on issues that include introducing the catalytic converter, energy conservation, and the use of renewable energy. Then too, like other EU states, Germany is juggling a complex, politically contested energy mix and is heavily dependent on outside energy sources. These, especially in the case of oil and gas, have large geopolitical implications that regularly surface in debate.

So is there anything distinctive about Germany? At least three things suggest themselves. First, there is the fact that from 1949 to 1990 there were two Germanys, each integrated into a different political bloc and as a result dependent on different markets and energy sources. One of those Germanys, the one that disappeared in 1990, was for reasons both geological and ideological a polluter on a quite heroic scale. That was above all a result of the burning of brown coal, or lignite, East Germany's major source of fossil fuel. Lignite had much to do with the fact that 80 percent of East Germany's surface water was designated as "polluted" or "heavily polluted" by the beginning of the 1980s.[7] The reduction of Soviet oil supplies in 1981 intensified the problem. By the late 1980s, per capita CO_2 emissions were twice as high in East Germany as they were

6 Thomas Friedman, *The World is Flat: A Brief History of the Twenty-First Century* (New York: Farrar, Straus and Giroux, 2005).

7 Joan DeBardeleben, "'The Future Has Already Begun': Environmental Damage and Protection in the GDR," in *The Quality of Life in the German Democratic Republic*, ed. Marilyn Rueschemeyer and Christiane Lemke (Armonk, NY: M. E. Sharpe, 1989), 152.

Figure 1: Leunawerke, a large East German chemical industrial complex, 1959. (Bundesarchiv, DH 2 Bild-F-01930 via Wikimedia Commons)

in West Germany. Coping with the aftereffects of that, including the clean-up costs, remained part of the larger landscape of energy decisions in unified Germany. A second distinctive feature of German energy debates has been the highly contested status of nuclear power, compared for example with France, and (the other side of the same coin) the exceptional zeal with which the development of renewable energy sources has been pursued. Both of these things are related in turn to a third, namely the extraordinary salience of green issues within German politics, on this as on other environmental questions—more so than in any comparably large and powerful advanced society (the best comparisons would be with smaller nation-states like New Zealand or the Scandinavian countries). I refer here not just to the existence of a well-established Green Party that has shared power at federal as well as state level, but to the broader resonance of environmental issues within German society. This has its own history, and in recent years there have been huge debates about that history, particularly over the purported National Socialist antecedents of today's conservationist and environmentalist movements: the question of "the green and the brown."[8]

8 See Joachim Radkau and Frank Uekoetter, eds., *Naturschutz und Nationalsozialismus* (Frankfurt am Main and New York: Campus, 2003); Franz-Josef Brüggemeier, Mark Cioc, and Thomas Zeller, eds., *How Green Were the Nazis? Nature, Environment and Nation in the Third Reich* (Athens, Ohio: Ohio University Press, 2005).

So let me turn to the past. Perhaps the best-known German writer on energy from a historical perspective is Rolf Peter Sieferle. He describes a fundamental transition in the late eighteenth century. Before that, energy meant harnessing wind, water, or the muscles of humans and other animals, and it meant burning wood or peat for heating and to power industrial processes like iron smelting. This was a solar energy regime, because it depended on the energy fixed in trees and peat and in the plants that made animal and human muscle power possible. Then came the historic shift to fossil fuels, energy provided by what Sieferle in a striking phrase calls the "subterranean forest": first the coal that fired industrialization (and still provided more than 90 percent of German energy needs in the 1930s), then the oil that became essential to the mature industrial economy of the twentieth century. Writing in the early 1980s, Sieferle discussed the prospective end of the fossil fuel era and the question of what came next, which he posed as the issue of "nuclear versus solar" power.[9]

The Subterranean Forest is a wonderfully wide-ranging and stimulating work, but there are things to argue with in the model it presents, including the idea that the whole period from the Neolithic to the late eighteenth century formed a unitary solar energy regime. Sieferle's account also makes the transition to fossil fuels seem more sudden than it was; it neglects hydroelectric power and tends to foreshorten the quite long modern history of advocacy on behalf of wind, solar, and other alternative forms of renewable energy. So I want to present a modified version of his model, indicating how different energy constraints and choices have presented themselves to Germans over the last two hundred years. As my title indicates, I also want to show the contexts of political power and cultural perceptions within which choices were made.

Let me look first at the initial transition to coal during what used to be called the Industrial Revolution. Most historians these days prefer to think of a more long-term, less explosive process of industrialization. And, in fact, the speed with which coal and the steam power it generated took effect can easily be exaggerated. Human muscle power remained crucial in a key sector like construction through the nineteenth century.[10] As late as 1875 more than half of all horsepower generated in Württemberg came from water mills; even in industrially advanced Saxony the figure was still over one-third.[11]

9 Rolf Peter Sieferle, *The Subterranean Forest: Energy Systems and the Industrial Revolution* (Cambridge: The White Horse Press, 2001), originally published in Germany as *Der unterirdische Wald* (Munich: C. H. Beck, 1982).

10 Construction accounted for 10 percent of the German labor force in 1875, 16 percent in 1907.

11 Rudolf Berthold, ed., *Geschichte der Produktivkräfte in Deutschland von 1800 bis 1870* (Berlin: Akademie-Verlag, 1990), 395.

Figure 2 (l.): Bauern beim Einsammeln und Abtransport von Holz [Farmers during Collection and Transportation of Wood] by Wolf Helmhardt von Hohberg, 1695 (Deutsche Fotothek via Wikimedia Commons)

Figure 3 (r.): Rundshorn Forest, Lower Saxony, 2011 (By Losch, CC-BY-SA-3.0 via Wikimedia Commons)

But there is another, even more important point: the transition to coal has often been seen as a necessity, the way out of a bottleneck caused by the crisis of wood shortages in the eighteenth century, a time when wood-burning was a crucial energy source. Sieferle emphasizes this, as did an older generation of economic historians. Most prominent among them was Werner Sombart, whose classic work *Der Moderne Kapitalismus* argued that coal had rescued capitalism from a wood shortage caused by deforestation, while at the same time (this was Sombart the cultural conservative) instituting the great transformation from an "organic" economy based on wood to an "inorganic" economy based on coal, metal, and synthetic materials.[12]

But was there a wood shortage? This has been the subject of a major debate and the most persuasive current answer is that there was, in fact, no critical shortage of wood in the late eighteenth century. Joachim Radkau was the first to cast serious doubt on the wood-shortage thesis 30 years ago, and subsequent local studies have confirmed his skepticism.[13] It is true that there were diverse and growing kinds of demand for wood as the eighteenth century went on—as firewood, in construction and industrial processes, and as a commercial export commodity rafted down the Rhine to Dutch shipbuilders. There were undoubtedly localized shortages. Yet claims of wood shortage, whether they came from officials or peasants, were often instrumental; they cannot be taken at face

12 Werner Sombart, *Der Moderne Kapitalismus* (Berlin: Duncker and Humblot, 1902).

13 Joachim Radkau, "Holzverknappung und Krisenbewusstsein im 18. Jahrhundert," *Geschichte und Gesellschaft* 9, no. 4 (1983): 513–43; Radkau, "Zur angeblichen Energiekrise des 18. Jahrhunderts: Revisionistische Betrachtungen über die 'Holznot'," *Vierteljahrschrift für Sozial- und Wirtschaftsgeschichte* 73, no. 1 (1986): 1–37. Radkau summarizes his arguments in *Wood: A History* (Cambridge: Polity, 2012), 156–71. An outstanding monograph is Christoph Ernst, *Den Wald entwickeln: Ein Politik- und Konfliktfeld in Hunsrück und Eifel im 18. Jahrhundert* (Munich: Oldenbourg, 2000).

value. Peasants complained about the scarcity of wood as a way of asserting traditional rights to the fruits of the forest; officials used similar claims as an argument in favor of tighter public control of a valuable resource in the name of scientific forestry. There was, in short, no chronic wood shortage: the old energy regime was not exhausted. The reason for the transition to coal was not so much a resource bottleneck or ecological crisis but an "institutional crisis," as Radkau has called it.[14] The previous system of resource allocation was breaking down because of disputes over forest codes and the control of wood. The shift to coal-fired steam power, although technologically complex, was institutionally simpler—politically more acceptable, if you want. Sombart and others were wrong. And this is important, because arguments about unsustainability, about dwindling reserves or resources, would feature so often in later energy debates. For example, advocates of nuclear power in the 1950s and 1960s often built their case by analogy, arguing that just as coal had once been the solution to an energy-supply crisis, so nuclear power was now the solution to diminishing coal reserves.

So what about coal reserves themselves, viewed historically? If it is true, as I have suggested, that we tend to see coal and steam as having a more immediate impact than they actually did, it is also true that we too easily overlook how quickly concerns arose about coal as a finite resource. Even before coal had become important in more than a few German regions, we find mine owners from one of those regions, the Ruhr, already worrying in 1827 about extracting too much coal, "*da alles seine Grenzen hat*" (because everything has its limits). Here, we have the language of limits, almost a century and a half before the Club of Rome report.[15] Concern about this issue was widely expressed later in the nineteenth century, even as coal production in Germany grew at a fantastic rate. Coal output tripled between the 1880s and 1913, at which date Germany was mining a quarter of the world's coal.[16] Just as the British economist William Stanley Jevons had warned in 1865 about finite coal reserves, so German commentators did the same.[17] Clemens Winkler, professor of chemistry at the Freiberg Mining Academy, Saxony, warned in 1899 that the widespread availability of coal was an exceptional situation; it would end, and bring the threat of "atrophy" with it. Winkler sounds very much like our con-

14 Radkau, *Wood*, 158.
15 Joachim Radkau, *Natur und Macht: Eine Weltgeschichte der Umwelt* (Munich: C. H. Beck, 2002), 232.
16 David Blackbourn, *The Long Nineteenth Century: A History of Germany, 1780–1918* (Oxford and New York: Oxford University Press, 1997), 319–20.
17 On Jevons, see Sieferle, *Subterranean Forest*, 197–202. The key text is William Stanley Jevons, *The Coal Question: An Inquiry Concerning the Progress of the Nation, and the Probable Exhaustion of our Coal-Mines* (London: Macmillan, 1865).

temporary when he suggested that this day would be hastened by low energy efficiency, although we are more surprised by his argument that the use of coal to fire crematoria was another major cause of depleted reserves.[18]

Figure 4 (l.): German coal miners, 1952 (Bundesarchiv, Bild 183-16831-0002 via Wikimedia Commons)

Figure 5 (r.): Zollverein Coal Mine, Essen, 2005 (Prescot Pym via Flickr)

The reality that coal stocks were finite, that they constituted a one-time bank of stored energy, was a serious topic of discussion in Germany by 1900. There is evidence for this from an unlikely source. The issue was raised on two different occasions by Max Weber. When he spoke in 1904 at a Congress of Arts and Sciences in St Louis, one of Weber's themes was the advantage that the United States enjoyed economically because of its unparalleled resources. But, suggested Weber, this advantage would be fleeting: "We must not forget that the boiling heat of modern capitalistic culture is connected with heedless consumption of natural resources, for which there are no substitutes." It was, he warned "difficult to determine how long the present supply of coal and ore will last."[19] He reprised the theme in the bleak and dramatic closing pages of his 1905 work, *The Protestant Ethic and the "Spirit" of Capitalism*, where it can be found immediately before the celebrated passage

18 Gottfried Zirnstein, *Ökologie und Umwelt in der Geschichte* (Marburg: Metropolis-Verlag, 1994), 128–30.
19 Max Weber, "Capitalism and Rural Society in Germany," in *From Max Weber: Essays in Sociology*, ed. H. H. Gerth and C. Wright Mills (London: Routledge and Kegan Paul, 1948), 366.

about the "iron cage." The ascetic calling of the Puritans had unwittingly helped to build the "mighty cosmos of the modern economic order," argued Weber. That mighty cosmos "determines, with overwhelming coercion, the style of life *not only* of those directly involved in business but of every individual who is born into this mechanism, and may well continue to do so until the day that the last ton of fossil fuel has been consumed."[20]

Anxiety about diminishing coal stocks was one of the concerns that drove the upsurge of enthusiasm for "white coal," or hydroelectric power, in the early twentieth century. There were many arguments for tapping the "capital from the mountains."[21] Hydroelectric power was, in the first place, a renewable form of energy. There was also a geopolitical argument that Germany could not afford to be left behind in exploiting this "national asset" when others were doing so.[22] Richard Hennig warned: "It looks at present as if all the leading industrial nations whose industrial importance rests on coal are facing serious competition from a number of newly rising countries whose economic future appears very favorable thanks to abundant hydroelectric power."[23] Foreign successes were all around. Switzerland was often singled out for effectively exploiting its Alpine resources and the Swiss Rhine. Others pointed to Italy and Scandinavia. Then there was the United States. German commentators were mesmerized by the huge hydroelectric plant that began operations at Niagara Falls in 1895. The more discerning looked enviously to California, the real pioneer of American long-distance electricity transmission, where the Pacific Gas and Electric Company of San Francisco began harnessing energy from the streams of the Sierra Nevadas in the 1890s.[24] There was a distinctive geographical pattern of support for hydroelectric power within Germany. Its heartland was the coal-poor south. Bavaria had the largest resources of hydroelectric power; Baden had the greatest in proportion to population. For many of its supporters in these states, and in neighboring Württemberg, where the progressive People's Party was its greatest advocate, hydroelectric power was not only

20 Max Weber, *The Protestant Ethic and the "Spirit" of Capitalism*, ed. Peter Baehr, trans. Gordon C. Wells (London: Penguin, 2002), 120–21.
21 Fischer-Reinau, "Die wirtschaftliche Ausnützung der Wasserkräfte," *Bayerisches Industrie- und Gewerbeblatt* (1908): 112.
22 "Über die Bedeutung und die Wertung der Wasserkräfte," *Zeitschrift für die Gesamte Wasserwirtschaft* 2 (1907): 8.
23 Richard Hennig, "Deutschlands Wasserkräfte und ihre technische Auswertung," *Prometheus* 20 (1908): 11.
24 Ernst von Hesse-Wartegg, "Der Niagara in Fesseln," *Die Gartenlaube* 53 (1905): 34–38; Theodor Koehn, "Der Ausbau der Wasserkräfte in Deutschland," *Zeitschrift für die gesamte Turbinenwesen* 5 (1908): 463–64; Wilhelm Müller, "Wasserkraft-Anlagen in Kalifornien," *Die Turbine* 5 (1908): 32–35.

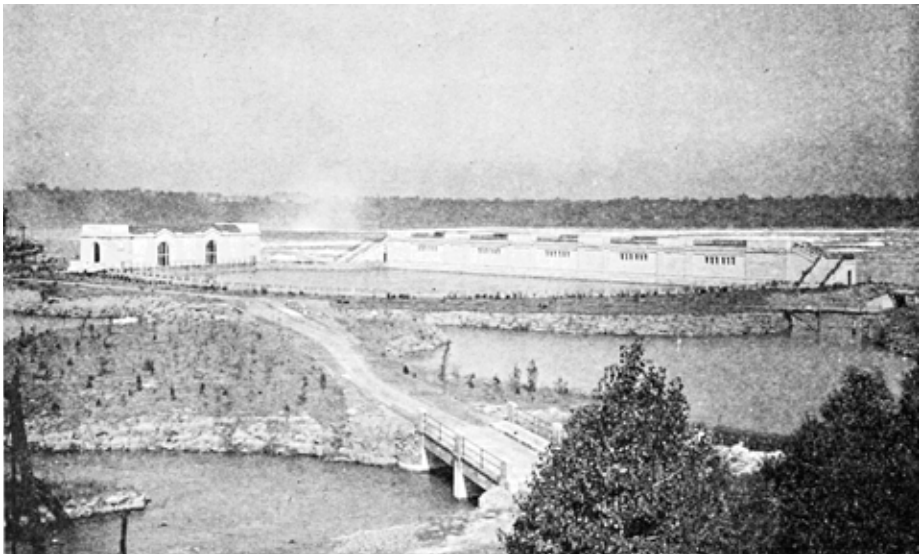

Figure 6: Ontario power plant and the surrounding area at Niagara Falls, 1908 (Unknown author via Wikimedia Commons)

a substitute for coal: it was an especially virtuous southern and "liberal" energy source much superior to the "conservative" Prussian energy of the northern coal barons. One commentator suggested that hydroelectric power offered a "powerful, continuous, cheap form of energy independent of strikes, coal syndicates, and petroleum rings." In the words of another enthusiast, hydroelectric power would be "the main energy source of the future."[25]

Many of these hopes turned out to be illusory. The commercial aggressiveness of companies like Rhenish-Westphalian Electricity (RWE) of Essen meant that by the end of the 1920s the hydroelectric resources of the south were controlled by large power combines headquartered in the north, in Berlin or the Ruhr. More than that, however, the economic payoff of hydroelectric power never matched the hype. Those who had warned about "effusive hopes," "boundless" enthusiasm, and even "megalomania" turned out to be right.[26] The amount of power eventually generated by large dams was

25 E[mil] Mattern, *Der Thalsperrenbau und die Deutsche Wasserwirtschaft* (Berlin: A. Seydel, 1902), 74; P. Ziegler, "Ueber die Notwendigkeit der Einbeziehung von Thalsperren in die Wasserwirtschaft," *Zeitschrift für Gewässerkunde* 4 (1901): 52.

26 E[mil] Mattern, *Die Ausnutzung der Wasserkräfte* (Leipzig: W. Engelmann, 1921), 991 (reporting critics, not his own views); Badermann, "Die Frage der Ausnutzung der staatlichen Wasserkräfte in Bayern," *Kommunalfinzanzen* 13 (1911): 154–55; J. L. Algermissen, "Talsperren—Weisse Kohle," *Soziale Revue* 6 (1906): 159–60.

less than expected because of the other purposes the dams were intended to serve, such as flood protection and maintaining a constant water level in rivers to serve the needs of inland shipping. The cost of the electricity was greater than anyone had predicted, and hydroelectric power came to provide a much smaller share of the German energy mix than virtually all engineers expected a century ago.

There are many parallels with the hopes invested in nuclear power in the 1950s and 1960s. Among opinion-formers—politicians, journalists, scientists, and engineers—a powerful consensus developed that, at a time when the long-term availability of coal seemed questionable, nuclear power represented the future. It was an example of science-based progress that would, so the argument went, supply cheap and inexhaustible energy. Large claims were made for the second generation of breeder reactors to come, and for the eventual bounty of nuclear fusion.[27] At its peak, Germany did indeed obtain some 30 percent of its electricity from nuclear power. The figure was 22 percent in 2010, and today is under 18 percent. But the cost was much greater than anticipated. Construction costs were underestimated; the "load" factor, the amount of time nuclear plants were actually online, was overestimated. By the end of the 1980s, moreover, the landscape was littered with abandoned projects like the Kalkar breeder and the Wackersdorf reprocessing plant.[28] According to one calculation, the total subsidies provided to the nuclear industry since the 1950s—the cost of building research prototypes and other R & D subsidies, of failed projects like fast-breeder and high-temperature reactors, of plant closings, restoration and rehabilitation of sites, and of tax exemptions for eventual disposal of nuclear waste materials—amount to some 63 billion euros.[29] One of the sharpest critics of nuclear energy, Klaus Traube, had an insider's knowledge of these costs because he managed Germany's fast-breeder reactor program in the 1970s. Added to these costs there is, finally, the hidden cost of the state assuming the financial risk of a nuclear accident because the insurance companies are unwilling to take it on.

In the case of coal, hydroelectric power, and nuclear energy, there is, intertwined with the history of the institutional and political considerations that shaped them, another

27 Joachim Radkau, *Aufstieg und Krise der deutschen Atomwirtschaft 1945–1975: Verdrängte Alternativen in der Kerntechnik und der Ursprung der nuklearen Kontroverse* (Reinbek: Rowohlt, 1983).

28 See Frank Uekoetter, "Fukushima and the Lessons of History: Remarks on the Past and Future of Nuclear Power," in "Europe After Fukushima: German Perspectives on the Future of Nuclear Power," *RCC Perspectives* 2012, no. 1: 17.

29 Hermann Scheer, *Energy Autonomy* (London and Sterling, VA: Earthscan, 2007), 103–4.

history: a history of cultural perceptions. It is a history of enthusiasm and fear, high hopes and high anxieties. I want to say something about each of these aspects. Let me turn first to the enthusiasm and the high hopes. Each of these new sources of energy captured the imagination of contemporaries and fostered extravagant, even utopian claims. The coal-fired factories of industrializing Germany were an object of awe, and it is very striking from the perspective of our own time how the image of the factory chimney belching smoke remained a positive image into the twentieth century—a marker of productivity. The coal-powered steam engine, meanwhile, became *the* great nineteenth-century symbol of progress. For political liberals, the steam locomotive was the force that would overthrow aristocracy and banish "backwardness." Friedrich Harkort believed that the railway engine would be the hearse that conveyed the nobility to the graveyard. The liberal historian Johannes Scherr wrote in 1858, with wonderfully unclouded certainty: "With each new iron steed that travels the rails, a piece of feudal-

Figure 7 (l.): German workers leaving a factory, ca.1948–1955 (US National Archives and Records Administration via Wikimedia Commons)

Figure 8 (r.): Ironworks Borsig, Berlin by Karl Eduard Biermann, 1847 (Public domain via Wikimedia Commons)

ism falls into the abyss of an irrecoverable pass."[30] The power of steam was associated with emancipation more broadly. It was a demonstration of the human capacity to transcend the constraints of nature, to conquer time and space. A large body of doggerel verse expressed this enthusiasm, works like Karl Beck's "Die Eisenbahn" (The Railway) and Anastasius Grün's "Poesie des Dampfes" (Poetry of Steam). Max Maria von Weber, eldest son of the composer and a writer who was also a former railway engineer, was credited by a friendly critic with having "discovered the poetry of rails." His publisher's

30 David Blackbourn, "Progress and Piety," in *Populists and Patricians: Essays in Modern German History,* ed. Blackbourn (London: Allen & Unwin, 1987), 152; Wolfram Siemann, *Gesellschaft im Aufbruch: Deutschland 1849–1871* (Frankfurt am Main:Suhrkamp, 1990), 90.

introduction to a posthumous collection of Weber's essays gives a good sense of their tone: "Mightier beyond compare than steed or chariot, than oar or sail, it is the new and powerful motor of our day: steam, which with aquiline speed, guides ocean castles and rolling towns."[31] It would be possible to offer many more examples of this kind of enthusiasm for the liberating energy of coal-powered steam. It can be found among scholars and scientists, politicians and popular writers, in newspapers and in best-selling family journals like *Die Gartenlaube* and *Über Land und Meer*.

Similar enthusiasm accompanied the earliest advocacy of hydroelectric power. The waters of the Alps were the "Eldorado of European hydroelectric power." An engineer in Karlsruhe called the energy that could be won by harnessing the Rhine "the true Rhine Gold."[32] In new specialist journals like *Die Turbine* (The Turbine) and *Weisse Kohl* (White Coal), but also, again, in popular magazines, hydroelectric power was portrayed as an energy source that was not only cheap, reliable, and inexhaustible, but clean, hygienic, and a motor of social emancipation. It would free Germany from the coal monopolists, spread the benefits of civilization to the countryside via electrification, rescue the small craftsman who adopted the electric motor, and free the housewife through labor-saving devices. There was a decidedly technocratic cast to this kind of enthusiasm. In the words of Emil Mattern: "The gaze of the engineer must free itself from petty everyday tasks and boldly lay down a direction for the development of hydroelectric power over years and decades, one that will not shackle its free development and creativity."[33] Above all, hydroelectric power was sold as a "modern" form of energy produced by men in white coats. Even the new measurement of energy, the kilowatt hour, seemed like a symbolic break with the old, that is, with "horsepower." As one writer put it: "There is . . . something wrong when an engineer has to measure the prospects of a hydroelectric installation on the basis of what a horse costs."[34]

Anyone reading about the enthusiasm for nuclear power in the postwar years will be struck by the similarity of the utopian claims being made. These formed one part of a

31 Manfred Riedel, "Vom Biedermeier zum Maschinenzeitalter: Zur Kulturgeschichte der ersten Eisenbahnen in Deutschland," *Archiv für Kulturgeschichte* 43 (1961): 106–7; Dolf Sternberger, *Panorama of the Nineteenth Century,* trans. Joachim Neugroschel (Oxford: Oxford University Press, 1977), 20–23. See also David Blackbourn and Geoff Eley, *The Peculiarities of German History: Bourgeois Society and Politics in Nineteenth-Century Germany* (Oxford: Oxford University Press, 1984), 185–87.

32 P. Ziegler, *Der Talsperrenbau* (Berlin: W. Ernst & Sohn, 1911), v; Franz Kretz, "Zur Frage der Ausnutzung des Wassers des Oberrheins," *Zeitschrift für Binnenschiffahrt* 13 (1906): 368.

33 Mattern, *Ausnutzung*, 1005.

34 Fischer-Reinau, "Ausnützung der Wasserkräfte," 103.

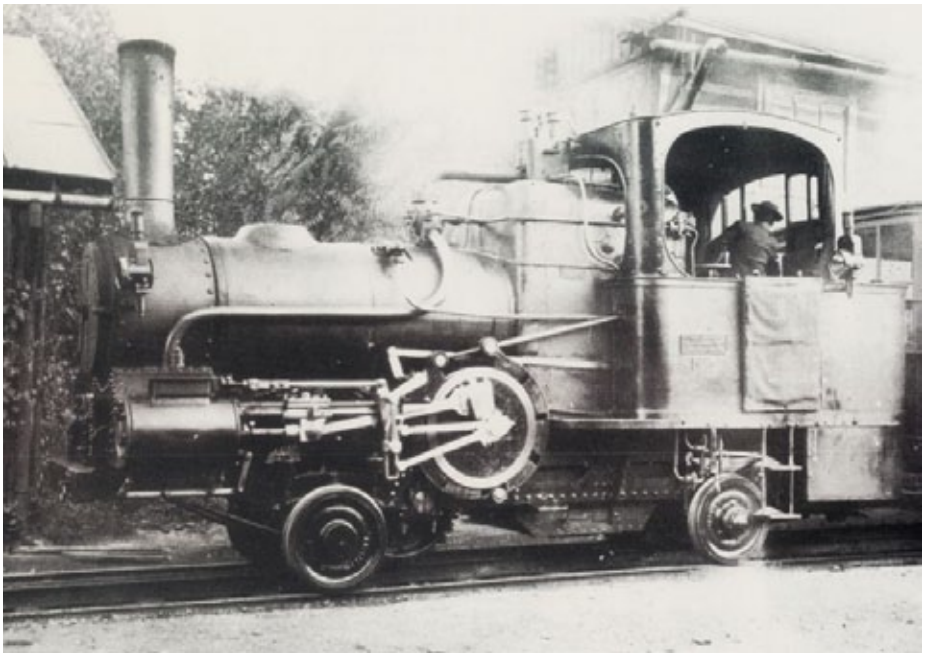

Figure 9: Old Kahlenberg steam engine, ca. 1875 (Unknown author, public domain via Wiki Media Commons)

larger pattern of sentiment that Gottfried Zirnstein has called "technological euphoria."[35] If the atom bomb was the symbol of hell, the peaceful use of nuclear power represented the promise of paradise on earth. There was, so it seemed in the dizzy optimism of the early years, nothing that nuclear power could not do. It could provide heat and light, power ships and planes, desalinate oceans, and heat greenhouses in the frozen tundra. Like hydroelectric power, nuclear power was presented as a cheap, clean, socially emancipatory form of energy. The promise of the peaceful uses of nuclear power drew liberal and left-leaning intellectuals, such as Karl Jaspers and Ernst Bloch.[36] A measure of the euphoric hopes invested in nuclear energy is evident in the case of the German Social Democratic Party (SPD). The SPD discussed an "Atomplan" at its 1956 conference, where it was argued that nuclear power would issue in "the beginning of a new era for humanity." Just as progressive advocates of "white coal" had once praised hydroelectric power as a challenge to the conservative coal barons, so the SPD now argued that if the power of the coal lobby could only be broken and the necessary investments

35 Zirnstein, *Ökologie und Umwelt*, 210.
36 Scheer, *Energy Autonomy*, 95.

made in nuclear power, this would "help decisively in securing democracy at home and peace between peoples. Then the atomic age will become the age of peace and freedom for all."[37]

Those were the high hopes. What about the high anxieties that greeted new forms of energy? Working back from the present, fears about nuclear power are familiar to us all. There was never the same degree of popular enthusiasm for this energy source as there was among German scientists, politicians, and journalists. During the search for sites for the first nuclear power stations there was local hostility, and public protests occurred, protests typically painted in the press as "backward-looking." Opinion polls in the 1950s showed that two-thirds of respondents still associated nuclear power with bombs and war—not unreasonably, given the debates taking place over rearmament and the stationing of nuclear weapons on German soil. In 1958, just eight percent of the population favored the civil use of nuclear power; twice as many feared it could lead to nuclear war. There were also doctors, Bodo Manstein the most prominent, and conservative writers like Günther Schwab, who warned about the dangers of a nuclear accident and its likely effects.[38] In later decades this issue would grow in importance and become a major part of the Green movement that reshaped German politics in the 1970s and 1980s. A well-organized movement mounted major protests against nuclear power plants at Wyhl and Brokdorf and against nuclear waste and reprocessing plants at Gorleben and Wackersdorf. These were local campaigns, but they achieved national resonance. German protests about nuclear power also owed something of their rhythm to the global impact of disasters like Three Mile Island (1979), Chernobyl (1986), and Fukushima (2011).

Less well-known is the opposition that initially greeted the advocates of dam-building and hydroelectric power. There was popular concern about safety when the earliest German dams were constructed in the 1890s. This was understandable. Germany's entry into dam-building took place against a background of spectacular dam collapses. Britain suffered a series of disasters in the mid-Victorian years, culminating in the collapse of the Dale Dyke Dam near Sheffield in 1864, when 250 people died. Problems with insecure dams in metropolitan France were followed by the failure of the Al Habra Dam in Algeria, with the loss of two hundred lives. The collapse of the

37 Franz-Josef Brüggemeier, *Tschernobyl, 26. April 1986: Die ökologische Herausforderung* (Munich: DTV, 1998), 205.
38 Ibid., 206–7. See also Radkau, *Aufstieg und Krise.*

Figure 10: Anti-nuclear demonstration in the Hofgarten, Bonn, 1979 (By Hans Weingartz, CC-BY-SA-2.0-de via Wikimedia Commons)

South Fork Dam in Johnstown, Pennsylvania, in 1889 produced a death toll of more than two thousand. Then came the disaster of the Bouzet gravity dam on the French Moselle, which was built in 1881 by two of France's most celebrated civil engineers and collapsed fourteen years later. Otto Intze, the leading figure in modern German dam-building, was very mindful of public concern and saw the task of publicizing the safety of German gravity dam construction as an essential part of his work. Intze's "tireless agitation" helped to "dispel the still widespread concerns about the accumulation of such powerful masses of water behind artificial dams."[39] He was not entirely successful. There is evidence that the cost of German dams was increased (and returns therefore lowered) because many were overbuilt to allay public anxiety. That is especially true of the string of dams constructed in Silesia during the early years of the twentieth century, beginning with the Marklissa Dam on the River Queiss. Intze, who designed the Marklissa, complained that some extra strengthening of the crown of the dam had been undertaken "out of exaggerated regard for the fears of the population." Engineering colleagues also blamed the ultra-conservative design on "the fears of the Silesian population." The view that an ignorant and panicky public had to be mollified was not unique to Germany. Frederick Haynes Newell, head of the US Reclamation

39 C. Wulff, *Die Talsperrengenossenschaften im Ruhr- und Wuppergebiet* (Jena: Fischer, 1908), 2–3.

Service, said that his agency favored solid dams partly because of appearances: plans were prepared with a view "to being not merely safe but looking safe."[40]

For all the technocratic scorn of the engineers, public anxiety was not so irrational. As one popular writer on the subject noted in 1909, the history of dams was the history of dam failures.[41] Even at the time, there were critics who argued that engineering calculations did not take into account shear stresses and uplift forces in German gravity dams: pressures that make a dam ride up on the Archimedes principle "like a boat on the water" and reduce the effective weight of the wall. These criticisms would later become fully accepted. German dams were built to last for centuries, but many belied that confidence. Some needed attention almost as soon as they went into operation. The Hennetal Dam, opened in 1905, was permanently closed in 1949 because the wall was unstable. Others had their water levels drastically lowered on safety grounds or were expensively retrofitted in the later twentieth century. The true extent of the structural problems was downplayed out of concern over public panic. It is worth noting that some two hundred dams collapsed worldwide during the twentieth century, thirty-three in the United States alone in the years 1918–53. Through a combination of conservative design, careful construction, rigorous inspections, and sheer good fortune, no German dam has failed since the modern era of dam-building began in the late nineteenth century—except, that is, when bombing attacks during World War II destroyed the Möhne and Eder dams, with large casualties.[42]

Popular fears about safety therefore accompanied the era of dam-building and hydroelectric power, as they did the nuclear era fifty years later. There are other parallels. Just as wine-growers near the nuclear power plant at Wyhl feared the impact of the cooling towers on the local climate, so there was concern that the large bodies of water created by hydroelectric dams would alter the microclimate (advocates often accepted that this would occur, but argued that the changes would be for the better). Hydroelectric and nuclear plants both led to criticism of the larger impact that intrusive new installations would have in rural areas. Dam-building meant that villages and farmland were lost when valleys were flooded; there was concern over the effect of

40 Citations for the quotations from Intze, his colleagues, and Newell can be found in David Blackbourn, *The Conquest of Nature: Water, Landscape, and the Making of Modern Germany* (New York: W. W. Norton, 2006), 244.

41 Hennig, "Deutschlands Wasserkräfte," 232.

42 Blackbourn, *Conquest of Nature*, 246–49, has references and further details.

damming rivers on fish populations and other fauna and flora. But most contemporary criticism from nature conservationists was made on aesthetic grounds, emphasizing the impact of dams and hydroelectric plants on the landscape. The Walchensee plant in Bavaria was a classic instance.[43] That criticism persisted for decades. It is why, and this is a wonderful historical irony, some nature conservationists in the 1950s welcomed nuclear energy because it did less visible damage to the landscape.[44]

Figure 11 (l.): Edersee Dam, 2012 (By SJB1120, CC-BY-SA-3.0 via Wikimedia Commons)

Figure 12 (r.): Walchansee power plant machine room, 2006 (By LuckyStarr, CC-BY-2.5 via Wikimedia Commons)

Of course, early coal-based industrialization also had numerous critics, on left and right. It dramatically transformed the landscape and brought new dangers: mining accidents, boiler explosions, new levels of airborne and waterborne pollution, and seriously damaging effects on non-human species. All were controversial issues at the time. Following Barrington Moore, the environmental historian Joachim Radkau has suggested that no population anywhere in the world would actually have chosen the fossil-fuel-based industrial economy of the nineteenth century, had the choice been presented.[45] From the writings of Marx and Engels onwards, the adverse effects of capitalist industrialization became a hot topic among historians, part of the "standard of living" debate. For an early wave of environmental historians, the long trajectory of pollution then became a staple issue.[46] And yet, the steam power that coal made

43 Ibid., 228–41.

44 For example, the Bavarian conservationist Otto Kraus, cited in Raymond H. Dominick, *The Environmental Movement in Germany: Prophets and Pioneers*, 1871–1971 (Bloomington, Indiana: Indiana University Press, 1992), 161.

45 Radkau, *Natur und Macht*, 232–33.

46 A useful introduction to some of the best work in this vein can be found in Franz-Josef Brüggemeier and Thomas Rommelspacher, eds., *Besiegte Natur: Geschichte der Umwelt im 19. Und 20. Jahrhundert* (Munich: C. H. Beck, 1987).

possible not only came to be accepted, but was popularly embraced, especially in the form of the railway and the steamship. The railway inspired popular songs and newly opened railway and steamship services were festively celebrated. No local history of a German town in the middle decades of the nineteenth century lacks its description of the railway opening, complete with local dignitaries, ribbons, brass bands, toasts, and the hurrahs of the crowd. A whole section of the popular *Leipziger Illustrierte Zeitung* was devoted to these celebrations. Local communities actively sought a station connecting them to the rail network, as they did not seek hydroelectric or nuclear power plants. The closest present-day analogy with this embrace of railway and steamship is popular identification with the automobile, perhaps because in both cases the energy use in question is associated with mobility.[47]

In this brief sketch I have tried to show how historical decisions and debates over coal, hydroelectric power, and nuclear power—the "past futures" of energy use—were shaped by a combination of resource assessment and risk assessment, economic interest, "expert" opinion, institutional-political structures, and a complex array of cultural perceptions. I looked particularly at the last of these, because the cultural responses to these forms of energy when they were once new have usually not been considered side by side. Are there any general points that emerge? Let me suggest three.

The first concerns the idea of energy mix. This essay has been concerned with coal, hydroelectric, and nuclear power. All have a place in the present German energy mix (although that will be true of domestically generated nuclear power only until 2022) along with other energy sources I have not discussed. These include oil, on which Germany now depends for its transportation needs; natural gas, most prominently the Russian gas purchased in a controversial deal with Gazprom, which is used mainly for heating; and renewables, which Germany has been a global leader in developing. One of the things I have tried to show is that this energy mix is nothing new. Even in the classic age of coal-powered industrialization, other forms of energy remained in use. Think about the years around 1900: the amount of coal being mined was unprecedented, and increasing fast, but in rural areas wood was still being burned for domestic heating, and in the moorlands of northwest Germany peat-burning served the same purpose. In Oldenburg and East Friesland, in fact, peat continued to hold its

47 Details and references in Blackbourn, *Long Nineteenth Century*, 272–73.

own against "King Coal" as a widely-used energy resource. The amount of peat dug in the Berumer Fen more than doubled between 1850 and 1880, while the number of peat ships operating out of Papenburg and the East Friesland fen colonies in the 1880s (around 750) was larger than ever before. Peat-fired iron works were established in some fen colonies; in Oldenburg there were even locomotives that ran on peat. Peat remained in demand through the end of the nineteenth century. Its price was high enough to bring in a satisfactory return but low enough to make it profitable.[48] Meanwhile, small businesses still survived in upland valleys using the power of old-fashioned waterwheels, even as large hydroelectric plants were being celebrated as the next big thing. And in those same years, serious debate about renewable energy began. Matthias Heymann's history of wind power in Germany begins in 1890; it was in the early twentieth century that a German Nobel Laureate in chemistry, Wilhelm Ostwald, coupled his warnings about the depletion of fossil fuels with a detailed argument in favor of harnessing solar energy.[49] A snapshot of 1900, as of other times, including today, reveals a jostling together of different energy sources, a mixture of what was, what is, and what is to be, of past, present, and future. Then as now, of course, there was never agreement about what truly represented "the future."

That brings me to a second point. Past, present, and future forms of energy have often been bound up with each other in unexpected, even paradoxical ways. Let me illustrate what I mean with some examples drawn from subjects discussed in this essay. It was the commercial clear-cutting of trees in the eighteenth century that uncovered coal in a western-bank region of the Rhine, a region that would later become known as the Saarland. That outcome, which shaped the economy and society of the Saarland coalfield for more than a century, could not have been imagined in the eighteenth century. Or consider another example. Peat-cutting was historically a labor-intensive affair, as readers of Theodor Fontane's *Wanderungen durch die Mark Brandenburg* will recall. Fontane describes thousands of seasonal laborers working in the 1850s under an all-powerful "peat lord" in the Wustrau moors, just as their counterparts did in the moors of the East Friesland peninsula. What changed this regime, and prolonged the economic viability of peat, was the arrival of mechanized cutting machines and baling presses. The most dramatic innovation was the appearance of a machine that cut

48 Blackbourn, *Conquest of Nature*, 144–61.
49 Matthias Heymann, *Die Geschichte der Windenergienutzung, 1890–1990* (Frankfurt am Main: Campus, 1995).

deep beneath the surface and turned up the mineral wealth underneath. That machine was the steam plough.[50] Finally, let me offer an example from the world of dams. Very soon after the modern era of German dam-building began, the size of dams became very much larger (contemporaries referred with awe to "giant dams," or *Riesentalsperren*) and their use for the new generation of hydroelectric power was enthusiastically hyped. Yet the dams began small, and they were not designed to turn modern turbines. Otto Intze's earliest clients were the owners of small businesses that used waterwheels as their energy source. They suffered from the problem of uneven water levels, a result partly of upland deforestation, and from the competition posed by large concerns on the Ruhr, powered by coal and steam. That is the paradox of Otto Intze's achievement. He got his start by building two small dams on tributaries of the Ruhr, financed by small cooperatives that served the interests of small wire mills and hammer mills. The "grand master" of German dams, the prophet of a bold new technology, began by seeking out a way to prop up a dying form of production. Only later—although not much later— did larger industrial concerns and hydroelectric advocates enter the picture.[51] These examples illustrate what Hegel called the "cunning of reason." Or perhaps they simply demonstrate what historians, certainly historians who have written on the environment, are familiar with as the importance of unintended outcomes.

That is an idea I want to hold on to as I turn to the third and final point of these closing observations, which concerns present-day choices. When I first gave a version of this essay, in September 2007, the debates over energy in Germany were similar to today's debates in many ways, but different in one very important way. They were similar in the marked degree of consensus between political parties and in the public on many issues related to energy and the environment. It was and remains common ground in Germany, as it most certainly was not and is not in the United States, that fossil fuel reserves are dwindling and we must prepare for a world in which they are in short supply; that emissions from fossil fuels produce damaging, potentially catastrophic climate change; that energy saving must be vigorously pursued; and, not least, that alternative, renewable energy sources have a significant and growing role in the future energy mix. The one big difference, of course, is that in 2007 there were still heated arguments over nuclear power. The nuclear lobby maintained that alternative energy was too expensive, and would be too slow coming online to fill the gap left by coal if Germany were to meet its

50 Blackbourn, *Conquest of Nature,* 160–61.
51 Ibid., 207–9.

pledged reduction in CO_2 emissions. Nuclear energy was needed, at least as a "bridging technology." This was the so-called "nuclear renaissance" of the early twenty-first century. The backlash against the claims made for renewable energy and the revaluation of nuclear energy were evident in the press, in newspapers such as the *Frankfurter Allgemeine Zeitung,* in weeklies such as *Der Spiegel*, and even in a magazine like *Stern*, which supported campaigns against nuclear power plants in the 1970s and 1980s. That changed after the Fukushima Daichi disaster. *Der Spiegel* immediately declared "the end of the nuclear age" on its cover.[52] Then, on 30 May 2011, just one year after Angela Merkel's government had extended the life of German nuclear power plants for an additional twelve years, until well into the 2030s, her government reversed course and announced an accelerated phase-out of nuclear reactors by 2022. At the end of June the German parliament voted overwhelmingly in favor.

Figure 13 (l.): Minamisoma city, Fukushima prefecture affected by the tsunami of earthquake and Fukushima Daiichi Nuclear Accident, 2011 (Hajimi Nakano via Flickr)

Figure 14 (r.): Anti-nuclear demonstration, Baden-Württemberg, 2011 (Grüne Baden-Württemberg CC-BY-SA-2.0 via Wikimedia Commons)

Frank Uekoetter argued persuasively in a *Perspectives* issue on Fukushima last year that this marked only the last act of what was, in fact, a long farewell to nuclear energy that was more complex than it seemed. I am very sympathetic to his view that, in the case of nuclear power, nothing turned out as expected—that "nuclear energy had a peculiar ability to make people of all camps look stupid."[53] My own argument in this essay has strongly emphasized the unintended consequences and the frequently dashed expectations associated with earlier energy choices. Where, then, do we stand today? In particular, how should we view the current euphoria for renewable energy?

52 Uekoetter, "Fukushima and the Lessons of History," 9.
53 Ibid., 26.

When Germany hosted the international conference "Renewables 2004," Environment Minister Jürgen Trittin proclaimed that the age of renewable energy had begun. Seven years later, when her government made its historic *volte-face* in the wake of Fukushima, Chancellor Merkel said that Germany had the opportunity to be the first advanced economy to make the transition to a different kind of energy regime. And Germany clearly is a world leader in wind and solar energy: successful new companies like Enercon, Nordex, and Fuhrländer in wind power, and Solon SE, Q-Cells, Conergy, and SolarWorld in solar energy, have emerged as global concerns. German companies now successfully export solar panels and wind rotors, just as an earlier generation of German firms exported green technologies in fields such as filtering and recycling. Renewable energy legislation that has its origins in the early 1990s feeds subsidized renewables (above all, wind power) into the electricity grid, encourages the use of biofuels, and funds major R & D projects in fuel cell and hydrogen technology. By the first half of 2012, renewable energy sources provided 23 percent of Germany's electricity, double its share in 2006. The nation went from well below the average of OECD countries to well above the average in a short period of time, and its share of electricity generated by renewable energy forms is now larger than it is in any other major country. This has created a leap in "green" jobs, not only in direct production and services but in ancillary occupations, from wind rotor repair men to consultants who advise investors on the complex renewable energy subsidies. The total number of jobs in the green energy sector is usually given as 370,000, double the number in 2004, many of them in small and medium-sized companies. Indeed, the history of renewable energy might be described as the embodiment of E. F. Schumacher's "small is beautiful." The four large German energy concerns control a very small share of renewable energy. Small groups such as municipalities, farmers, and local energy cooperatives, can take advantage of the generous "feed-in" tariff to sell their surplus power to the grid.[54]

So: *Wo ist das Problem*—what's the catch? Surely any environmentally-minded person would welcome this bold and historic shift in German energy policy, from the fuels that represented yesterday's future (coal and nuclear power) to the energy source of today's future (renewables). Yet the situation is actually much less clear-cut. In the first place, renewable energy sources have not been able to meet the shortfall in electricity resulting from the phase-out of nuclear power plants. Burning more coal has been one answer, which will certainly make it harder to meet Germany's commitment to reduce greenhouse

54 "Germany's Energy Transformation: Energiewende," *The Economist,* 28 July 2012.

gas emissions by 40 percent from 1990 levels by 2020. Importing electricity has been another answer. Some of it has come from Poland, where—shades of former East Germany—electricity is produced by burning brown coal. But electricity has also been imported from France and the Czech Republic, where it is generated by nuclear power. The shortfall in electricity has been partly made good, in other words, by importing nuclear-generated electricity from Germany's neighbors. If this seems contradictory, consider the case of Baden-Württemberg. Its newly elected Green minister-president, Winfried Kretschmann, urged the utility company EnBW to close its remaining nuclear plant in the state as soon as possible. Yet Baden-Württemberg has a stake in the Fessenheim nuclear plant across the French border. Small wonder that this kind of fastidious arm's-length relationship with nuclear power attracts the label "hypocrisy," which is the word used by Konrad Kleinknecht, former climate representative at the Deutsche Physikalische Gesellschaft.[55]

Figure 15: Energy park (solar panels and pumped-storage hydroelectricity) in Geeshacht, Schleswig-Holstein, 2009 (Quartl via Wikimedia Commons)

We also need to be properly critical of the claims made on behalf of renewable energy. Amid the euphoria, it is easy to pass over the objections and potential shortcomings. Some objections are more persuasive than others. One critique that became popular

55 Laura Gitschier and Alexander Neubacher, "Greenwashing after the Phase-out: German 'Energy Revolution' Depends on Nuclear Imports," *Spiegel-Online*, 15 September 2011. The Deutsche Physikalische Gesellschaft (German Physical Society) has 59,000 members globally, making it the largest organization of physicists in the world.

during the "nuclear renaissance" has wind turbines as its target. It is posed in conservationist terms. Wind farms, so the argument runs, represent a threat to the landscape. We find this criticism as early as the 1998 Darmstadt Manifesto signed by over a hundred university professors, most of them scientists, it is worth noting, in contrast to the mainly humanistic supporters of the nineteenth-century *Heimat* protection movement.[56] Wind farms have been rejected within nature reserves like Wattenmeer on the North Sea coast, although they have been built close by. The apocalyptic tone of some critics matches many past denunciations of early industrialization or hydroelectric power stations. The Berlin professor Hans-Joachim Mengel has suggested that the effects of wind turbines in the Uckermark north of Berlin devastated the landscape more than anything since the Thirty Years War of the seventeenth century. The playwright Botho Strauss expressed the view that "no phase of industrialization has caused such brutal destruction of the landscape as wind power."[57]

The absurdity of these claims—their lack of any sense of historical proportion—makes them easy to mock. It is true that the very rapid expansion of German wind power generation has not been environmentally without cost. As wind farms have become larger and turbines have grown from 400 feet (120 meters) to 600 feet (180 meters), the effects have gone beyond mild aesthetic nuisance. The powerful noise of the rotors turning together and the flashing red lights at the top of the windmills that warn low-flying planes combine to produce the "disco effect" of noise and visual pollution. And yet, insofar as harnessing wind power is an alternative to burning fossil fuels, can one really balance these adverse effects on German rural residents against the potentially life-threatening consequences of greenhouse gas emissions on inhabitants of the global South, where the effects of those emissions will be most strongly felt? A variant of the "environmental" case against wind power concerns the threat to bird life. Bird carnage is often cited as a highly emotive argument against wind turbines. In Germany bird protection societies have taken municipalities to court over proposed wind farms.[58] Wind turbines do indeed cost avian lives; but the evidence suggests they cost far fewer lives than windows, cars, industrial installations, or cats. Direct comparison between the avian mortality caused by fossil fuel-burning plants and wind farms

56 www.windaction.org/documents/96.
57 *The Daily Telegraph*, 4 April 2004. See also Scheer, *Energy Autonomy*.
58 "Vogelschützer ziehen vor Gericht," *Oberhessische Presse*, 14 May 2013.

Figure 16: Wind farm at Pfaffroda, Saxony, 2009 (eclipse.sx)

indicate that the former cause something like 15–20 times as many deaths per kilowatt hour of electricity produced.[59]

A second set of arguments also raises questions about the environmental cost of green energy, but does so in a different way. Alternative energy itself requires energy. We must recognize the high energy inputs of the aluminum required to manufacture the turbines that capture wind power, and the similar energy inputs associated with constructing and maintaining the systems necessary for concentrating relatively low-density solar energy. The good news here is that improved wind turbine and photovoltaic cell technologies means new installations start to deliver net energy gains sooner than was once the case. Germany is also strongly committed to the increasing use of biofuels, in line with EU guidelines. Here the questions are more numerous. How much energy does it actually require to create a gallon of biofuel? If land is used for the purpose of creating biofuels, does this involve trade-offs with the supply of food (the so-called food versus fuel debate)? And what is the impact on biodiversity of planting land with biofuel crops?

59 Benjamin K. Sovacool, "The Avian Benefits of Wind Energy: A 2009 Update," *Renewable Energy* 49 (2013): 19–24.

Behind these questions, all of them posed by committed environmentalists, lurks another. What about the real cost of these initiatives? One study from early 2012 on the German biofuel mandate bears the title: "Biofuel: At What Cost?" Its authors note that "it is unlikely a market for biofuels in Germany would exist in a competitive and unregulated fuel market."[60] They go on to try to determine the full extent of the public subsidies, direct and indirect, a task made very difficult by the lack of transparency. If this study had been commissioned by the Federation of German Industry and cited in the financial pages of the *Frankfurter Allgemeine Zeitung*, it would no doubt be dismissed by some as another piece of sniping against green energy. In fact, it was prepared for the well-respected, Canadian-based International Institute for Sustainable Development. We are rightly skeptical today about the claims made in the 1950s and 1960s on behalf of nuclear power, in part because the true cost of the public subsidies and the record of false starts are now so much more apparent. We should be equally skeptical now about the claims made on behalf of renewables. Just because there have been plenty of self-serving and unfair attacks on the subsidies to alternative energy sources by representatives of nuclear and fossil fuel interests, that is no reason to suspend our disbelief. The question of opportunity cost is there, whoever raises it. If the pursuit of a more environmentally sustainable energy policy requires good public policy (as we would surely agree it does), then it matters whether public money is used to support solar energy or energy-saving initiatives, the biofuel mandate, or research and development into carbon capture and sequestration. These are just a few examples of choices; there are many others. The point is that the language of priorities cannot be suspended just because the long-term objective of sustainability is a noble one.

At the conference on energy at which I first gave a version of this paper, the distinguished German climate scientist Hans Joachim Schellnhuber delivered a paper that ended with a vision of a European energy "super-grid" that would bring together wind power from Britain and northern Europe, hydroelectric power from Scandinavia and the Alps, biomass energy from central Europe, and solar power from southern Italy, Greece, Spain, and possibly North Africa. The original European Economic Community had been founded, argued Schellnhuber (unpersuasively), to secure the food supply: Why not future cooperation to secure the energy supply? The passage of just a few years,

60 Anna Rauch and Michael Thöne, "Biofuels—At What Cost? Mandating Ethanol and Biodiesel Consumption in Germany," Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development, Geneva, January 2012, 33.

which have revealed the striking lack of European unity in the face of the Eurozone crisis, already make that vision seem very time-bound. The prospect of EU members riddled with high levels of public debt investing in such a super-grid currently seems remote, and if they had begun constructing it in the years before the financial crisis hit, the reality would have been quite different from the exuberant vision of Schellnhuber. My purpose here is not to mock the value of a European-wide energy grid. It is to sound a skeptical note and make a plea for sobriety, or *Sachlichkeit*, in these matters. I am concerned about the *Rausch*, the sheer intoxication, that has accompanied the current "energy transition" in Germany. This is something we have seen before. Frank Uekoetter astutely notes the "unpleasant memories" of earlier euphoria and refers to blueprints that stretch decades into the future.[61] The unbridled advocates of renewable energy will, of course, say that this time things are different. That is what enthusiasts always say.

As we have seen, it is a characteristic of new sources of energy that their advocates present them (in perfectly good faith) as a means of social emancipation. That was true in the time of steam, hydroelectric, and nuclear power. The current enthusiasm for renewable energy has a lot in common with the enthusiasm a century ago for hydroelectric power. "White coal" would break the shackles of the coal barons; it would help the little man, the farmer, and the craftsman. The actual achievements, as we saw, were more modest. Now we are told that renewable energy is intrinsically democratic. Advocates trumpet its base in numerous small, decentralized energy cooperatives, municipal initiatives, and solar parks that extend down to the level of apartment blocks. But what comes next? Local entities prize their self-sufficiency and many scorn proposals to build up the electrical transmission grid. So do some renewable energy entrepreneurs, like Matthias Willenbacher of Juwi Holding AG, a major builder of wind and solar projects, who stated: "You can put the grid development plan directly in the bin."[62] It is tempting to celebrate this local self-sufficiency, and to speculate that perhaps renewable energy can avoid the fate of hydroelectric power a century earlier, which began as a utopian dream in the south and ended as an ancillary of old-style power companies based in the north. Tempting—but much too simple. Local energy production is itself a product of federal subsidy, and many local ambitions make no

61 Uekoetter, "Fukushima and the Lessons of History," 25.
62 See "Germany's Energy Transformation."

sense without the grid. The state of Schleswig-Holstein, for example, plans to generate three times as much renewable energy as it consumes and export the surplus to the south and west. Other states and localities have equally ambitious plans that, if realized, would dump excess power on the market. The grid would seem to be a friend to renewable energy, allowing unpredictable surges and shortfalls in wind- and solar-generated energy to be equalized. Yet it is resisted in the name of local control, and by opposition to new transmission masts in the name of environmental conservation. If Hans Joachim Schellnhuber's vision of the European super-grid represents one form of energy utopianism, then the celebration of local energy self-sufficiency represents another. The one sure lesson of the past is that energy choices have a way of confounding expectations. That is a good reason to avoid technological euphoria and not to insist that this time things are different as Germany enters an era in which renewables will clearly play a much larger role.

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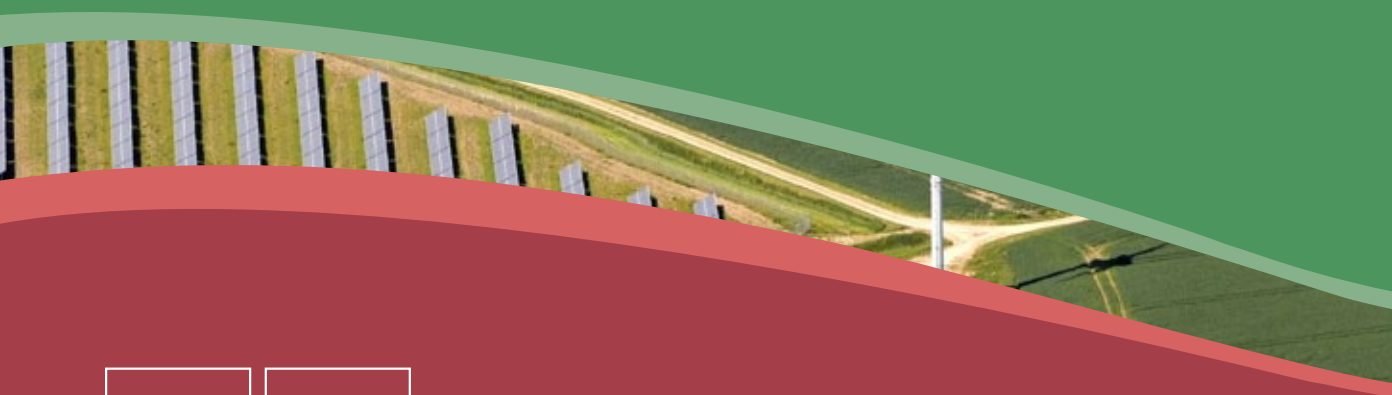
In this volume of *RCC Perspectives*, esteemed historian David Blackbourn follows the challenge of energy production in Germany over the past two hundred years—from wood and coal, to hydroelectricity and nuclear power, and finally to emerging renewable technologies. Suggesting parallels between past and present energy choices, Blackbourn examines the political, cultural, and economic contexts of German energy regimes against a backdrop of increasing global debate. As Germany enters a transitional phase in energy policy, with the end of its nuclear age and the tentative steps towards "green" energy sources, can we look to the past to understand the present and even the future?



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