



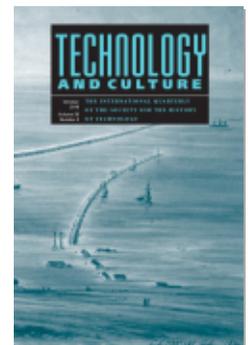
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Wood Waste and Race: The Industrialization of Biomass Energy
Technologies and Environmental Justice

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Wood Waste and Race

The Industrialization of Biomass Energy Technologies and Environmental Justice

SARAH MITTFELDLT

ABSTRACT: In the 1980s, engineers developed new ways to use one of humanity's oldest fuel sources—wood—to create electrical power. This article uses envirotechnical analysis to examine the development of a wood-burning power plant in Flint, Michigan, and argues that when public officials began working with major energy corporations to build industrial biomass facilities in the 1980s and 1990s, new energy technologies designed to run on renewable fuels became part of an entrenched fossil fuel-based power structure that maintained deep historical inequalities. Like other examples of environmental injustice, the burdens of industrial-scale biomass power systems tended to fall on poor, nonwhite communities. By exploring the creation of the Genesee Power Station as part of an envirotechnical regime in Flint, this research seeks to develop conceptual bridges between the history of technology, environmental history, and environmental justice, and demonstrates the use of history to inform contemporary debates about sustainability.

Introduction

On a cold December night in 1993, Santa Claus attended a public hearing about a proposed wood-burning power plant in Flint, Michigan. Before the meeting began, Santa stood outside with a sign that read: “Santa Ain’t Goin’ Down This Chimney.”¹ Despite the economic and environmental

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1. Mike Stobbe, “Residents Take Last Shot at Halting Power Plant.”

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benefits of using a renewable fuel source to produce electricity, many local residents feared that the power plant would exacerbate public health problems in their predominantly African American neighborhood. The Michigan Department of Natural Resources had authorized the air quality permit for the Genesee Power Station in 1992, and community leaders had spent the following year appealing the decision on the grounds of racial discrimination and inappropriate technology. Local residents wondered why the state held public meetings in the middle of the workday at Kearsley High School, five miles away from the proposed power plant in a predominantly white neighborhood, instead of at the Carpenter Road Elementary School, which was located directly across the street from the proposed plant in a predominantly black neighborhood. When officials eventually held a public hearing at the Carpenter Road School in 1994 after construction of the plant had begun, citizens were greeted, not by a red-cheeked Santa Claus, but by armed guards authorized by the state. Because there had been no armed guards at prior meetings in predominantly white venues, residents perceived the extra show of force to be racially motivated.²

Despite local opposition and an open investigation by the EPA's Office of Civil Rights, the Genesee Power Station began operating in 1995 and continues to produce power today for Michigan's largest utility, Consumers Energy. In January 2017, twenty-four years after the community began to protest the plant, the man dressed as Santa—Father Philip Schmitter, one of the main organizers of the opposition—heard a final decision about the civil rights investigation. The EPA found that the preponderance of evidence in the case suggested that Michigan's environmental regulatory agencies had discriminated against African Americans in the permitting processes for the Genesee Power Station in the years between 1992 and 1994. The director of the EPA's Civil Rights Compliance Office, Lillian Dorka, also noted that by not engaging all populations more fully, the Michigan Department of Environmental Quality's current policies would continue to perpetuate racial injustice.³

In this case study of biomass energy in Flint, Michigan, I argue that existing political institutions, material infrastructure, and racial disparities shaped the development of renewable energy technologies. In places where environmental racism was deeply entrenched, industrial-scale renewable energy technologies maintained racial injustices. Without careful attention to how different types and scales of renewable technology applications interact with existing sociopolitical dynamics and racial divisions, future energy decisions are likely to reproduce the inequalities of the past. Because

2. Sister Joanne Chiaverini and Father Phil Schmitter to Kary L. Moss, 2 August 1995, folder "SFPC_GCPS_Correspondence_52_1994-95," box 1, Saint Francis Prayer Center Records, Bentley Historical Library, University of Michigan Special Collections (hereafter cited as SFPCR).

3. Lillian S. Dorka to Heidi Grether, 19 January 2017, www.epa.gov.

historians of technology are trained to examine the broader nontechnical aspects of energy adoption, we are particularly well positioned to unveil the often hidden social dynamics embodied in new energy technologies. As a result, historians have an opportunity to contribute to broader conversations about sustainable energy systems.⁴

The history of the Genesee Power Station contains important lessons for thinking about the environmental justice implications of new energy technologies and industrial-scale renewable energy systems in particular. The 36MW power plant was designed to feed the existing grid with electricity generated from burning a green fuel source: woodchips. The wood supply would come from tree trimmings and land clearing as well as from industrial wood waste from construction and demolition projects. Although burning wood to heat buildings was an ancient practice, in the 1980s engineers developed new technologies that used wood to produce electrical power on an industrial scale.

Like all energy sources, burning biomass has environmental and public health consequences. Although on a ton-for-ton basis, burning wood produces less carbon dioxide, sulfur, and nitrogen oxides than burning coal or oil, it produces more carbon monoxide, volatile organic compounds (VOCs), and particulates.⁵ Furthermore, without proper sorting and pollution controls, burning industrial wood waste releases toxic chemicals into the air. One of the possible toxins released when burning demolition and construction wood is lead, which is particularly harmful to children's cognitive development and one of the main reasons why Flint residents were concerned about the proposed plant.⁶ Like the fossil fuel-based systems that renewable technologies replaced, industrial-scale biomass facilities tended to concentrate the negative consequences of energy production in places that lacked political power. In doing so, they contributed to the historical disenfranchisement of minority populations and of communities of color in particular.

When local and state government officials began working with corporate leaders of major energy companies to build large, centralized wood-fired power plants such as the Genesee Power Station in the 1980s and 1990s, new energy technologies designed to run on renewable fuels became part of an older fossil fuel-based power structure that maintained deep historical inequalities. This power structure was reinforced by an environmental regulatory framework that focused more on future ambient air

4. Richard F. Hirsh and Christopher F. Jones, "History's Contributions to Energy Research and Policy," 106; Richard F. Hirsh and Benjamin K. Sovacool, "Wind Turbines and Invisible Technology," 705–34; Clark A. Miller, Alastair Iles, and Christopher F. Jones, "Social Dimensions of Energy Transitions," 135–48.

5. M. J. Bradley and Associates, "American Lung Association Energy Policy Development: Summary," 2011.

6. J. Michael Davis and David J. Svendsgaard, "Lead and Child Development."

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quality standards and less on the full participation of vulnerable populations in decision-making processes. Although framed as a technology that could help transition away from dependence on fossil fuels and that would promote economic growth, the Genesee Power Station became part of a sociopolitical and physical landscape that was a palimpsest of pollution. In Flint, a place that has come to symbolize the failure of environmental policy to ensure socially just outcomes, the burning of industrial wood waste to generate electricity for a large-scale utility perpetuated injustices associated with large, centralized fossil fuel-based energy technologies and resulted in disparities between how different groups experienced the consequences of new energy technologies. Like other examples of environmental injustice, the burdens of industrial-scale renewable power systems tended to lie in poor, nonwhite communities.

To illustrate how existing power structures and racial divisions shaped renewable energy development, this article employs envirotechnical analysis. The purpose of envirotechnical analysis is to reveal the often-invisible connections between technology and nature, and to show how those relationships have been mediated by political dynamics.⁷ One of the pioneers of envirotech scholarship, Sara B. Pritchard, defines the notion of envirotechnical regimes as “the institutions, people, ideologies, technologies, and landscapes that together define, justify, build, and maintain a particular envirotechnical system as normative.”⁸ My research builds on Pritchard’s work by developing the category of race as one of the key cultural and political dimensions of technological systems. The following analysis of renewable energy and environmental justice in Flint demonstrates the importance of understanding race as an inextricable aspect of the creation and maintenance of envirotechnical regimes.

Although envirotech scholars, like historians of technology in general, acknowledge that energy systems have distributed environmental burdens in unequal ways, few have closely examined relationships between racial divisions and the development of renewable energy technologies.⁹ In her

7. Foundational envirotech works include Leo Marx, *The Machine in the Garden*; Bruno Latour, *We Have Never Been Modern*; Donna Haraway, “A Cyborg Manifesto,” 149–81; Jeffrey K. Stine and Joel A. Tarr, “At the Intersection of Histories,” 601–40; Richard White, *The Organic Machine*; Mark Fiege, *Irrigated Eden*. For more recent envirotech scholarship and energy, see Sara B. Pritchard, *Confluence*; Timothy J. LeCain, *Mass Destruction*, 22; Edmund Russell et al., “The Nature of Power,” 246–59; James M. Turner, “Following the Pb,” 31–32.

8. Pritchard, *Confluence*, 23. Also see Sara B. Pritchard, “Joining Environmental History with Science and Technology Studies,” 1–17.

9. Foundational studies that examine how energy systems structured political power include Thomas P. Hughes, *Networks of Power*; Thomas P. Hughes, “The Evolution of Large Technological Systems,” 45–76; Martin Melosi and Joseph Pratt, *Energy Metropolis*; Joel Tarr, “Transforming an Energy System,” 19–37; Tyler R. Priest, “The Dilemmas of Oil Empire,” 236–51; Paul Sabin, *Crude Politics*; Alfred W. Crosby, *Children of the Sun*. Others have examined general winners and losers of fossil-fuel based

essay on the role of race and gender in the history of technology, Nina Lerman argues that historians of technology could benefit from race and gender theory by exploring how these “seemingly natural categories” have been constructed in the creation of technological systems.¹⁰ Similarly, environmental historians have had little to say about the role of race in structuring the social relations that have surrounded energy technologies or environmental debates more broadly.¹¹ By showing how racial dynamics influenced the creation of the Genesee Power Station, I aim to demonstrate the use of envirotechnical analysis for understanding how historical inequalities have shaped current energy regimes.

This investigation of race and renewable power in Flint also builds on scholarship from the field of environmental justice. Environmental justice scholars began to define environmental racism in the late 1980s as environmental practices or policies that disproportionately affected or disadvantaged communities based on race, either intentionally or unintentionally.¹² Several foundational studies in the field revealed that wastes associated with fossil fuel energy systems were typically placed in minority communities, and decisions about those technologies often failed to involve those who would be most affected by those systems.¹³ Few scholars have examined the environmental justice implications of renewable energy systems or how power structures associated with fossil fuels have influenced the development of renewable technologies over time.¹⁴ By developing conceptual bridges between the sometimes-disparate fields of the history of technology, environmental history, and environmental justice, this examination of a

energy systems. For example, see Christopher F. Jones, *Routes of Power*; LeCain, *Mass Destruction*.

10. Nina Lerman, “Categories of Difference, Categories of Power,” 894.

11. Carolyn Merchant, “Shades of Darkness,” 380–94; Kimberly K. Smith, *African American Environmental Thought*.

12. Benjamin Chavis Jr. and Charles Lee, *United Church of Christ Commission on Racial Justice, Toxic Wastes and Race in the United States*; Robert Bullard, “The Threat of Environmental Racism,” 23–26; “Principles of Environmental Justice”; Dorceta Taylor, “The Evolution of Environmental Justice Activism, Research, and Scholarship,” 280–301; F. O. Adeola, “Environmental Hazards, Health, and Racial Inequity in Hazardous Waste Distribution,” 99–126.

13. Studies that explore the relationship between environmental injustice and energy systems include Paul Mohai and Bunyan Bryant, *Race and the Incidence of Environmental Hazards*; Andrew Hurley, *Environmental Inequalities*; Luke W. Cole and Sheila R. Foster, *From the Ground Up*; Steve Lerner, *Diamond*.

14. Political scientists such as Gwen Ottinger and Kristen Shrader-Frechette have conducted important research exploring the environmental justice implications of different renewable energy technologies. I contend that historians of technology could do more to engage with scholarship on environmental justice, particularly in regard to renewable energy development. See, for example, Gwen Ottinger, “The Winds of Change,” 222–29; and Kristen Shrader-Frechette and Whitney C. Pressier, “Renewable Technologies and Environmental Injustice,” 88–93. Also see Kathleen Araújo, “Emerging Field of Energy Transitions,” 112–21.

Michigan Biomass

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- | | | |
|----|---------------------------|-------|
| 1. | Cadillac Renewable Energy | 36 MW |
| 2. | Genesee Power Sta. | 36 MW |
| 3. | Grayling Generating Sta. | 36 MW |
| 4. | Hillman Power Co. | 18 MW |
| 5. | Lincoln Power Sta. | 18 MW |
| 6. | McBain Power Sta. | 18 MW |

Totals **162 MW**
1.6 million tons
(2013)



Michigan
Biomass

FIG. 1 Map of Michigan biomass power plants developed in the 1980s and 1990s. (Source: Used with permission from the Michigan Biomass coalition.)

wood-burning power plant in Flint, Michigan, offers several important lessons for thinking about new energy technologies and demonstrates the use of history to address contemporary sustainability challenges.

Green Energy in a Predominantly Black Community

The Genesee Power Station was one of several new wood-burning power plants built in Michigan in the late 1980s and early 1990s, but it was the only facility not located in the state’s northern forests, as shown in figure 1. While most of Michigan’s new biomass plants were located in remote rural areas, the Genesee Power Station was built in a highly developed urban environment located at the end of Energy Drive on the northeast side of Flint, Michigan. The area was a picture of what sociologist Steven Dandaneau termed “dependent deindustrialization.” Flint’s dependence on external powers, specifically the transnational corporation General Motors, resulted in the systematic disintegration of the city’s productive capacity in the late twentieth century.¹⁵ In 1978 GM maintained a \$2 billion annual payroll in Flint and employed 80,000 workers, many of whom worked in the manufacturing plants on the city’s northeast side. By 1992, the number of those employed by GM declined to 50,000, and a community that once thrived on auto manufacturing struggled to sustain itself on a handful of recycling centers, a fuel storage facility, and asphalt and cement plants. As

15. Steven P. Dandaneau, *A Town Abandoned*.

thick vines snaked across the boarded-up buildings on Flint's northeast side, city officials grew eager to support new industries that could help alleviate the economic ruination of the 1970s and 1980s.¹⁶

For local officials, the Genesee Power Station represented a great financial opportunity. The original owners of the Genesee Power Station involved a partnership between CMS Generation Company (whose principal subsidiary was Consumers Energy), Black & Veatch (an engineering firm), and the Genesee Power Company. The corporate partners maintained that by bringing in \$1.8 million in annual tax revenues to the township, the facility would be the largest single taxpayer in the county. They also claimed that the plant would create over 200 jobs.¹⁷ Although the facility ended up providing about half that many jobs, the promise of employment was especially appealing to leaders of deindustrializing cities like Flint, where unemployment levels soared to 20 percent in the 1990s.¹⁸ Local political elites, including Flint mayor Woodrow Stanley, members of the Genesee County Board of Commissioners, and leaders of Genesee Township, lauded the economic benefits of the plant and urged state agencies to authorize the permits necessary for construction.

Using wood to produce power appealed to many people who were becoming increasingly aware of the environmental impacts of burning fossil fuels. The Genesee Power Company and its partners argued that the facility would reduce the necessity for burning coal and thus reduce sulfur emissions and the threat of acid rain. Earlier plans to promote energy independence, such as the 1977 National Energy Plan, had emphasized large, centralized technologies fueled by coal or nuclear power.¹⁹ Wood-energy advocates argued that biomass provided a less centralized and more environmentally benign alternative (see figure 2). They maintained that the impact of harvesting wood was less than the environmental cost of extracting coal and oil, and that as an inherently local fuel source, biomass could promote energy independence.²⁰

In addition to environmental arguments made by national biomass advocates, the Genesee Power Company noted that by burning 175,000 tons of wood waste per year, the plant would extend the life of local landfills. In order to procure a reliable supply of fuel for the plant, developers hired Mid-Michigan Recycling in 1994. Between 1995 when the plant began

16. Andrew R. Highsmith, "Demolition Means Progress," 348–68.

17. "Genesee Power Station: Converting Waste to Energy," folder 71, box 2, in SFPCR.

18. Brandon Ward, "The Promise of Jobs," 163–68.

19. Executive Office of the President, "The National Energy Plan," 1977.

20. National Forest Product Association Newsletter, 15 April 1977, box 345, folder: "Task Force on Energy and Forest Resources-6.76-12.76," Society of American Foresters Collection, Forest History Society Archives (hereafter cited as SAF Collection). Also see Dietmar W. Rose, "Fuel Forest versus Strip-Mining," 489–93; Sarah Mittlefehldt, "Seeing Forests as Fuel," 13–21.

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FIG. 2 "Split Wood Not Atoms." Some biomass advocates argued that unlike nuclear power, which tended to concentrate both physical and political power, wood energy had the potential to help decentralize energy systems. (Source: Fremont, Ohio, *News-Messenger*, 19 October 1981.)

commercial operation until 2002, the facility diverted 638,700 tons of wood waste and saved 1.13 acres of landfill space each year, according to a report published by the U.S. Forest Service. The report also noted that every year the Genesee Power Station displaced more than 100,000 tons of coal, 2,000 tons of sulfur dioxide, and 16,000 metric tons of carbon equivalent. The report, entitled "Successful Approaches to Regulating Wood Waste," highlighted waste diversion at the Genesee Power Station as one of the nation's great examples of using wood waste to produce power.²¹

CMS Generation Company and the Genesee Power Company emphasized that the power plant would follow all environmental laws and that the plant manager would work closely with local and state agencies to ensure compliance with air-quality regulations. The corporate owners noted that the location of the facility, just west of the Flint River, was already home to several polluting industries, including large recycling facilities and brown-field sites. Local officials such as Genesee Township supervisor William Ayres agreed with the corporate backers of the project. Ayres noted that the local zoning board had previously zoned the site for industrial development and that the new biomass plant would therefore be an appropriate use for that area. Moreover, Ayres told reporters with the *Flint Journal*, "This is a clean facility. The air coming out will be cleaner than the air coming in."²²

21. United States Forest Service, "Successful Approaches to Regulating Wood Waste," 17–18.

22. Mike Stobbe, "Planned Wood-burning Project Draws Fire."

In response to residents' concerns about pollution problems, local and state officials maintained that existing environmental regulations would prevent deteriorating conditions. Michigan's Department of Natural Resources (MDNR) was initially charged with overseeing the permitting process, though later Michigan's Department of Environmental Quality (MDEQ) took over as the state agency primarily responsible for ensuring compliance with environmental regulations. State officials maintained that the Genesee Power Station would rely on its fuel supplier to deliver waste wood chips that would be free of plastic, shingles, vinyl siding, and lead coatings. Because harmful materials would be removed in this presorting process, MDNR officials argued that the plant's choice of Best Available Control Technology (BACT)—a multiclone collector and an electrostatic precipitator—would be sufficient.²³

When the developers of the Genesee Power Station approached Gerry Decker, a contractor with North American Environmental Services, about procuring a reliable supply of biomass for the new plant, Decker was skeptical. He argued that the plant, located in the southeastern part of the state, would not be able to find 250,000 tons of green woodchips to run the facility all year, and he predicted that the bulk of the fuel supply would have to come from construction and demolition waste in the region. Decker expressed concern about plans to divert painted or treated wood. He argued that because any diverted material would have to go to the landfill for disposal, there was a "strong financial incentive to burn questionable material." He also questioned the ability of unskilled laborers to separate wood that had been treated with clear shellacs, varnishes, and polyurethanes that would be coming down a quickly moving conveyor—especially, he noted, "when a semi-load would be arriving every 15 minutes."²⁴

Decker had worked for two years at one of Flint's municipal recycling facilities and had conducted chemical analyses on demolition wood that had come into the facility—wood waste that would now be diverted to the new power station. He found that even on wood that had never been chemically treated, painted, or varnished, lead levels in Flint's wood supply were ten times higher than the MDNR's inert standard. Decker speculated that the lead inside the wood fibers came from ambient air pollution. Simply existing in the Flint area had exposed wood posts, beams, and other construction materials to lead, which had become engrained in the wooden infrastructure of the city over the years. This observation is particularly noteworthy when thinking about wood-burning technologies as environmental regimes. Wood wastes that were to fuel new energy systems were physically embedded with the environmental history of Flint, where toxic chemicals from past industries permeated the city's air, water, and

23. MDNR, Air Quality Division, Staff Activity Report, 20 November 1993.

24. Gerry Decker to Mary Charley, Air Quality Division, MDNR, 23 October 1992, folder 50, box 1, in SFPCR.

wood. The sociopolitical implications of the Genesee plant were not lost on Decker, who noted in a letter to state officials that “the proposed incinerator for Flint continues a national trend of siting incinerators and landfills in economically depressed, minority neighborhoods where local opposition is likely to be less effectively organized.”²⁵

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Despite the logistical and political challenges of organizing resistance to the project, many local residents argued that the plant would be a “punch-bowl of pollutants,” and they began to mobilize against it by holding meetings and attending public hearings (see figure 3).²⁶ They noted that the proposed plant was adjacent to a residential area with fourteen schools, eight mobile-home parks, two low-income housing projects, and many single-family dwellings.²⁷ According to the U.S. Census, 73 percent of the people living in the neighborhood adjacent to the plant were African American and 25 percent were white, compared to the broader demographics of Genesee County, which was 77 percent white and 21 percent black.²⁸ African American leaders such as Lillian Robinson and Janice O’Neal organized the Flint Neighborhood Coalition and worked closely with Father Philip Schmitter and Sister Joanne Chiaverini of the St. Francis Prayer Center. The center was located just south of the proposed power plant. Father Schmitter and Sister Chiaverini, who were both white, lived in the neighborhood and used their positions as religious leaders to help organize protests against the plant. Robinson, O’Neal, Schmitter, and Chiaverini worked with other organizations such as the Society of Afro-American People in Michigan and the Flint branch of the NAACP to protest the plant. Both black and white protesters argued that the selection of the plant site was an act of environmental racism.²⁹ African Americans would be most affected by the plant, but they had been largely excluded, either intentionally or unintentionally, from full participation in decision-making processes.

Members of the Flint Neighborhood Coalition were particularly concerned about the lead in the ash of construction and demolition (C/D) wood. Depending on the level of sorting, C/D wood had 110–500 times more lead than whole tree chips as shown in table 1. Members of the group noted in a letter to the regional EPA administrator that lead poisoning caused cognitive problems, kidney disease, blindness, seizures, and even death.³⁰ Because the power plant would be located just north of an elemen-

25. *Ibid.*

26. Ken and Linda Elston to William Rosenberg, 21 December 1992, folder 49, box 1, in SFPCR.

27. Philip Schmitter and Joanne Chiaverini to William Rosenberg, 15 December 1992, folder 49, box 1, in SFPCR.

28. As quoted in Liam Kelly, “Environmental Justice Case Study.”

29. Lillian Robinson to Michigan Pollution Control Commission, 26 October 1992, folder 49, box 1, in SFPCR.

30. Flint Neighborhood Coalition to Valdas Adamkus, 4 December 1992, folder 49, box 1, in SFPCR.

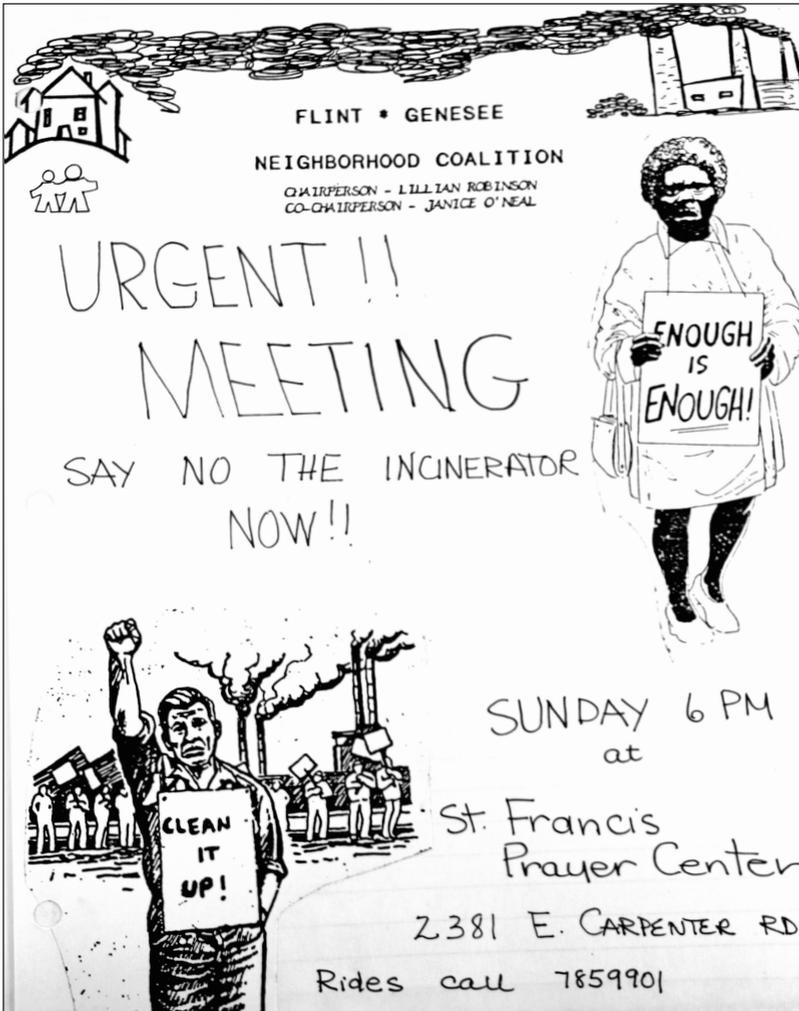


FIG. 3 Flyer notifying Flint residents about public hearing. (Source: Saint Francis Prayer Center Records, Bentley Historical Library, University of Michigan Special Collections. Reprinted with permission.)

tary school and because children were most susceptible to health problems associated with lead, community leaders argued that the state needed to take a closer look at the facility's plans for operation. The American Lung Association of Michigan also expressed concern that the way the state's air-quality permit had been written "open[ed] the way for the source operator to burn nearly any kind of waste that they desire."³¹ They pointed out that

31. Alexander Sagady to Flint Watt and Robert Miller, 24 October 1992, folder 50, box 1, in SFPCR.

TABLE 1
LEAD CONCENTRATIONS IN WOOD FUEL AND ASH PRODUCED BY BURNING WOOD (IN PPM)

	<i>Whole tree wood chips</i>	<i>Pallet wood waste chips</i>	<i>High-quality C/D wood waste chips</i>	<i>Low-quality C/D wood waste chips</i>	
OCTOBER	<i>Concentrations in wood</i>	0.6	9.3	149	585
2018	<i>Concentrations in ash</i>	28.5	1,192	3,204	14,283
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Source: Data from the Michigan Department of Natural Resources, Air Quality Division Report, "Determination of Best Available Control Technology (BACT) for Lead Emissions," 20 November 1993.

the permit contained no requirement for removing plastic materials, such as vinyl siding or roofing shingles that could contain asbestos, from demolition waste.

In addition to their fear about how potentially toxic pollutants might affect the community, residents also expressed concern about decision-making processes. On 1 December 1992, several Flint residents awoke before the sun rose to board a rented bus at 7:30 a.m. The state scheduled one of the first public hearings about the construction permit for the Genesee Power Station for 9:00 a.m. in Lansing, and the Flint group was determined to let their opposition be known. Members of the group grew increasingly frustrated as other agenda items delayed the hearing throughout the afternoon and into the evening. As Flint residents' faith that the state would hear their concerns dwindled, the blood sugar levels of three diabetics in the group plummeted. Finally, at 7:40 p.m., more than twelve hours after the group had left Flint, the hearing began. When the Flint group requested that the meeting be postponed so that the diabetics could get insulin, the state denied the motion. Officials maintained that the agency needed to make a decision that night because the corporate partners backing the Genesee Power Station needed resolution before they could begin construction.

As the proceeding began, residents began to sense that the structure of the hearing favored those in support of the plant—most of whom were white. Plant developers and local officials who supported the facility spoke first and were given plenty of time to speak; the state listed opponents last on the agenda. When their turn did come, one resident recalled that officials "rudely wave[d] a one-minute sign" in her face and cut her off "mid-sentence, in the middle of a thought."³² Opponents reported that after the only person of color on the commission had left and the remaining commissioners were half asleep, they called for a final vote at 12:40 a.m., fifteen hours after the original hearing time. In a 6-1 vote, the commission

32. Linda Elston to MAPCC (Michigan Air Pollution Control Commission), 16 March 1993, folder 51, box 1, in SFPCR.

granted the permit on 2 December 1992.³³ Angered by the process, residents argued that the state had acted as a “promoter of this project rather than a neutral technical evaluator.”³⁴

In response to concerns about decision-making expressed to MDNR, Frank Ruswick Jr. argued that the agency had listened to citizens’ concerns but did not have the authority to address them. “As a government official,” he wrote, “I am bound by the law. If the law allows certain behavior as long as a given standard is met, I am prevented from prohibiting that behavior.”³⁵ The federal Clean Air Act established National Ambient Air Quality Standards, and the implementation of those standards typically fell to the states. Since the law set levels of safe emissions, and the proposed facility had submitted documentation that explained how it would operate within allowable limits, Ruswick argued that his hands were tied; the agency had no legal grounds to deny the permit. He emphasized that because the proposed plant would be in compliance with environmental laws, there would be no need for concern. Moreover, Ruswick argued that the decision of where to locate the plant was ultimately made by the local zoning commission that had determined the area to be suitable for industrial development. He noted that it would be “quite inappropriate” for a state environmental agency to question the local government’s decision about zoning and land use.³⁶

Ruswick’s response illustrated how different scales of governance created tension when trying to achieve competing goals and also showed the limitations of environmental policy to address deeper social justice challenges involved in technological decisions. In this case, the state’s goal was to limit air pollution levels, while the local zoning board prioritized economic growth. Each level of government was singularly focused on either the environment or the economy. Addressing the disproportionate impacts that new pollution sources might have on the predominantly black residents who lived near the facility was not within the purview of either agency. This situation exemplifies how the implementation of renewable energy technologies was influenced by the interaction of existing political institutions, material realities, and racial disparities.

Not satisfied with the state’s response, community members in the northern Flint neighborhood sought federal intervention. Working with other state and national organizations, they filed nine appeals to the EPA that focused on charges of inappropriate technology and racial discrimination. Addressing claims about technology, the EPA’s administrative law

33. Lynn Fiedler, MDNR Supervisor, “Dear Interested Party . . .”, 7 December 1992, folder 49, box 1, in SFPCR.

34. Schmitter and Chiaverini to Rosenberg, 15 December 1992.

35. Frank Ruswick Jr. to Robert Soderstrom, 17 December 1992, folder 49, box 1, in SFPCR.

36. *Ibid.*

judge ruled that Michigan's Pollution Control Commission must investigate whether fuel cleaning could really be an effective control technology for lead emissions. To the claim of environmental racism, in 1993 the judge ruled that opportunities for public participation had been adequate, and dealing with racial discrimination was "beyond the scope of Air Quality's rules and regulations."³⁷

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Like other important environmental laws from the 1970s, the Clean Air Act did not contain provisions that required agencies to account for discriminatory impacts that may have resulted from the siting of power stations or other polluting industries. Although courts tested the boundaries of civil rights legislation in the late 1960s and 1970s, environmental statutes from that era typically failed to address how the burden of pollution disproportionately impacted communities of color. Like environmental regulators in other places, state officials in Michigan generally operated within the utilitarian framework of the law. They sought to promote public health by limiting air pollution levels to a certain threshold for the good of all. Yet because the new biomass plant was to be built in an area that had a history of heavy industrial use, it was difficult to predict how additional pollutants from the plant would interact with existing sources of pollution. In this sense, the implementation of environmental policies helped establish and perpetuate energy sacrifice zones—areas where small, often disadvantaged groups bore the burden of cheap energy for the majority's benefit. The EPA's initial ruling about the Genesee Power Station in 1993 demonstrated how the utilitarian ideology that shaped environmental policies in the late twentieth century resulted in the disproportionate impact of industrial pollution on minority communities.

Disappointed by the failure of traditional environmental law and policy to address environmental racism, activists in Flint looked to a growing national environmental justice movement for support. They sought help from national civil rights leaders such as Benjamin Chavis, whose expertise helped members of a predominantly low-income, African American community in Warren County, North Carolina, fight against state and federal environmental policies regarding the cleanup of PCB waste.³⁸ Lois Gibbs, whose grassroots activism at Love Canal helped inspire the national Superfund legislation, also came to Flint to help community members organize.³⁹ Cases such as those in North Carolina, New York, and Michigan brought national attention to the tension between social justice and environmental protection, and the environmental justice movement gained traction in 1994 when President Clinton signed Executive Order 12898. The order required that if a federal agency, or any agency that received fed-

37. Environmental Protection Agency, "In the Matter of Genesee Power Station," 838.

38. Eileen McGurty, *Transforming Environmentalism*.

39. Tammy Webber, "Area Activists Get Pointers from Veteran of Love Canal."

eral funding, was found to be in violation of Title VI of the 1964 Civil Rights Act, the EPA could withdraw funding to that agency.⁴⁰

Encouraged by Clinton's executive order and the creation of an Office of Civil Rights within the EPA, Flint residents submitted a complaint to the new EPA office in 1994. Kary Moss, a lawyer with the Sugar Law Center working on behalf of the Flint residents, claimed that the discriminatory siting practices involved in the Genesee Power Station were part of a "systematic pattern" by the MDEQ. She argued that the federal agency not only needed to look into the discriminatory practices involved in the permitting process for the new biomass plant, but that the EPA should "expand the scope" of its investigation to examine how environmental regulatory agencies—MDEQ in particular—had perpetuated environmental injustices in Michigan.⁴¹

In addition to testing the new environmental justice rules within the executive branch, local activists looked to the court system to make their case. Using precedents set in Iberville, Louisiana, Flint residents worked with the local chapter of the NAACP and became the first to apply Title VI to an environmental issue in Michigan. The plaintiffs in the case *NAACP vs. Engler* argued that environmental regulatory agencies overseen by Michigan governor John Engler had violated federal and state civil rights laws when they permitted the Genesee Power Station to operate. In 1995 the case went to a federal court, and the judge ruled that the plaintiffs did not have enough evidence to prove racial discrimination. That same year, just after the EPA's Office of Civil Rights opened an investigation about the permit for the plant, the Genesee Power Station officially began to operate.

As the EPA continued to investigate the case in 1998, lawyer Kary Moss wrote again to point out the irony of the situation: just two years after the plant was built, the Genesee Power Station was on the EPA's "significant violator" list.⁴² Between February 1996 and November 1997, the plant received twenty-six carbon monoxide violations, three nitrogen oxide violations, and seven opacity violations.⁴³ In a separate report in 1997, MDEQ found that wood waste at the plant contained heavy metals such as arsenic, mercury, and lead.⁴⁴ Moss noted that the state's position of "see no evil, hear no evil" was one that was working to "entrench racial discrimination

40. The EPA could not revoke permits or prevent the construction of projects approved by other agencies, however. Exec. Order 12898, 59 Fed. Reg. 7629 (16 February 1994).

41. Kary L. Moss to Dan J. Rondeau, 16 February 1995, folder 52, box 1, in SFPCR. Also see Kary L. Moss, "Environmental Justice at the Crossroads," 61–62.

42. Kary L. Moss to Mike Mathieson and Carlton Waterhouse, 20 January 1998, folder 55, box 1, in SFPCR.

43. "Genesee Power Station, Summary of Violations Identified in Emissions Monitoring," folder 54, box 1, in SFPCR.

44. Michigan Department of Environmental Quality, Air Quality Division, Activity Report: Miscellaneous, 26 November 1997, folder 54, box 1, in SFPCR.

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in the urban environment forever.”⁴⁵ At the same time, Governor John Engler insisted that the EPA’s continued “prying” into allegations of racial discrimination at the Genesee Power Station and at the proposed Select Steel mill nearby would have “a chilling effect on development in Genesee County.” He told a reporter with the *Flint Journal*, “We have enough challenges to face without this [environmental justice challenge].”⁴⁶

By the end of the twentieth century, the Genesee Power Station had joined a list of eleven major industries in the Flint area that were in significant noncompliance with federal requirements, and many questioned the ability of new environmental justice policies to address entrenched racial disparities.⁴⁷ Although local residents were still concerned about the health impacts of the Genesee Power Station, many had moved on to protest the state’s permit to build the Select Steel mill in 1998. Though it was never built, the Select Steel mill was to be located near the biomass plant, and residents feared it would further concentrate industrial pollutants. The *Detroit News* reported, “Despite spending millions of dollars to implement the [environmental justice] policy . . . the EPA has been unable to develop enforceable rules that untangle the web of social and economic factors that put industrial development and poor communities in such close proximity.”⁴⁸

The tangled web of social and economic factors that placed industrial development in poor communities—and communities of color in particular—continued into the twenty-first century. Today the Genesee Power Station continues to burn industrial wood waste along with tires, which were added to the fuel mix in 2011. Although in 2017 the EPA ruled that MDEQ violated civil rights laws during permitting processes for the Genesee Power Station between 1992 and 1994, the state insists that the power plant was not responsible for increased lead levels in the area. Recent epidemiological research suggests that even before the Flint water crisis in 2014–15, Flint’s children were exposed to persistent lead contributions in the city’s air and soils that came from a variety of proximate causes.⁴⁹ Thus, when biomass advocates in the late twentieth century worked with state officials to restructure the energy economy through renewable fuels, historic inequalities established by older systems of industrial production were occasionally replaced with new forms of injustice—particularly in places such as Flint, where, to local and state officials, existing industrial sacrifice zones seemed like appropriate places to locate new energy technologies.

Flint is an important place to study historical tensions between renew-

45. Moss to Mathieson and Waterhouse, 20 January 1998.

46. Tom Wickham, “‘Environmental Justice’ Dispute Harmful.”

47. “Notice of Significant Industrial Pollution Violation.”

48. “EPA Policy Questioned from the Start.”

49. Mark A. Laidlaw et al., “Children’s Blood Lead Seasonality in Flint, Michigan (USA), and Soil-Sourced Lead Hazard Risks,” 358.

able energy development, environmental advocacy, and civil rights activism, and this case study has implications that extend well beyond Michigan. The story of the Genesee Power Station reveals how environmental and energy policies structured the distribution of burdens associated with energy production and distribution. The case in Flint reminds planners and policymakers that in order to develop sustainable energy systems, addressing economic and environmental dimensions alone is insufficient. Greater attention must be paid to the sociopolitical context in which new technologies are deployed. By understanding renewable technologies such as biomass energy systems as envirotechnical regimes, where ideology and entrenched institutions are as much in operation as pyrolysis chambers, turbines, and electrostatic precipitators, we begin to see how race and social justice concerns have shaped—or failed to shape—decisions about energy.

Conclusion

All energy systems have had consequences that have affected different populations in different ways. As renewable technologies became more competitive with conventional fossil fuel-burning systems in the late twentieth century, and as the scale of those technologies increased, institutionalized inequalities from past fossil fuel-based systems extended into new systems of energy production, distribution, and consumption. Utilitarian policies that aimed to protect the nation's air and water supplies for the good of all often placed the environmental burdens of energy technologies in minority communities—places where people had little power to resist. In the case of Flint, when the state worked with local officials and corporate developers to deploy industrial-scale biomass energy technologies in a context that was stratified by race and income, the new power plant became one more of the dozen or so major polluting industries that placed the burden of pollution squarely on the shoulders of poor, mostly African American people.

The history of wood-burning technologies in Flint provides three lessons for historians of technology. First, this history suggests that envirotech scholars could engage more with questions about race and environmental justice. The racial and economic divides of the past and present are inextricably linked to tomorrow's energy technologies. By thinking of renewable energy technologies as being woven into existing envirotechnical regimes, we begin to understand new technological systems not as autonomous inventions that will quickly transform dominant political institutions but as continuous systems that grow out of existing political dynamics and cultural practices. This research suggests the need to expand the tools of envirotechnical analysis to examine more explicitly the ways in which race affects the dynamic interaction of ideologies, institutions, and the material dimensions of energy technologies.

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A second and related lesson from this history of wood-burning technologies is the importance of building theoretical bridges between the history of technology, environmental history, and environmental justice. For the past few decades, environmental historians and historians of technology have worked together to hone conceptual tools like envirotechnical analysis that have yielded fresh insights and have moved both fields in new directions. By addressing racial dynamics more explicitly in the study of envirotechnical regimes, historians of technology and environmental historians can contribute to the growing field of environmental justice. Also, by examining how historical processes have shaped disproportionate impacts of industrial pollutants on communities of color, environmental justice scholars can expand their set of analytical tools and unveil how patterns from the past influence current problems. Building theoretical bridges between the history of technology, environmental history, and environmental justice scholarship also helps understand some of the historical tensions between civil rights activism and environmental advocacy in the context of energy development.

The final lesson from this research relates to the use of the history of technology to inform contemporary debates about sustainability. In his 2016 Leonardo Da Vinci Medal address, Johan Schot offered an impassioned call-to-arms for historians of technology to use the historical imagination to engage in discourse related to energy decisions. He argued that history can be used to “challenge the view that there are no real alternatives to the currently dominant unsustainable energy . . . systems whose guiding routines are focused on intensive use of fossil fuels.”⁵⁰ Though timely, Schot’s plea is not a new one. In 1979 Carroll Pursell argued that historians of technology should “stop legitimizing what Schumacher has called ‘the forward stampede’ and lend support to ‘the homecomers.’”⁵¹ For Pursell, as for E. F. Schumacher, one of the founding fathers of the Appropriate Technology movement, the “forward stampede” was the singular focus on large-scale technological systems that bought unprecedented energy to consumers—and power to political elites—in the Western world. In contrast, the “homecomers” were those who advocated for the decentralization of technological systems and the use of appropriate technology.⁵² Like Schot, Pursell argued that historians have a responsibility to investigate different strains of the past—not just dominant fuel types and centralized systems of mass production but smaller applications and the stories of

50. Johan Schot, “Confronting the Second Deep Transition through the Historical Imagination,” 446–47.

51. Carroll Pursell, “The History of Technology as a Source of Appropriate Technology,” 21. Also see Carroll Pursell, “The Rise and Fall of the Appropriate Technology Movement,” 629–37.

52. E. F. Schumacher, *Small Is Beautiful*. Also see Amory B. Lovins, “Energy Strategy,” 65–96; Amory B. Lovins, *Soft Energy Paths*.

those people, organizations, and institutions commonly made invisible by fossil fuel-burning energy technologies.

If historians of technology want to contribute to the conversation about sustainable forms of energy, we would do well to explore a wider range of power systems and the sociopolitical dynamics associated with green energy. Since the pioneering work of Thomas Hughes, energy historians have tended to focus on large technological systems, fueled by coal, oil, gas, and nuclear power, and the national policies, infrastructure, and the hegemonic forces that built and maintained centralized systems of energy production and distribution.⁵³ Few historians have examined the development of renewable technologies, and even less is known about how differently scaled renewable applications have distributed benefits and burdens.⁵⁴ By examining how issues of race and inequality have shaped renewable energy development, historians of technology can help illuminate the limitations of past policies and can inform future decisions about sustainable energy systems.⁵⁵

STS scholar Sheila Jasanoff writes, “New energy futures will need to reconfigure the physical deep structures of civilization . . . that were shaped by the energy choices of the past.”⁵⁶ Envirotech scholars have shown how those physical structures were inextricably linked to institutions and ideologies that reinforced the concentration of both physical and political power. Historical perspectives can help illuminate how and why past cultures became trapped in patterns of thinking that led to centralized solutions and the political barriers that have prevented the decentralization of energy systems. By revealing the ideological and material consequences of a wider range of technological possibilities, historians of technology can remind decision-makers that implementing socially viable energy technologies will require confronting existing inequalities from our past. An active historical imagination is essential for thinking about a more sustainable future.

53. Hughes, *Networks of Power*. Also see Melosi and Pratt, *Energy Metropolis*; Tyler R. Priest, *The Offshore Imperative*; Sabin, *Crude Politics*; Jones, *Routes of Power*; Frank Uekotter, “Fukushima, Europe, and the Authoritarian Nature of Nuclear Technology,” 277–84.

54. In addition to Pursell’s work, other histories of renewable energy technologies include Vaclav Smil, *Energy Transitions*; John Perlin, *Let It Shine*; Frank Laird, *Solar Energy, Technology Policy, and Institutional Values*; Frank Laird, “Constructing the Future,” 27–49; Sarah Mittlefehldt and Codie Tedford, “Benefit or Burden?” 110–14; Bent Sorensen, “History of Renewable Energy Technology,” 8–12; Langdon Winner, *The Whale and the Reactor*.

55. For an explanation of the relationship between historians of energy technologies and public policy, see Richard Hirsh, “Historians of Technology in the Real World,” 6–20; and Benjamin Sovacool, “Rejecting Renewables,” 4500–13.

56. Sheila Jasanoff and Sang-Hyun Kim, “Sociotechnical Imaginaries,” 189.

Bibliography

Archival and Oral Sources

Bentley Historical Library, University of Michigan, Ann Arbor
Saint Francis Prayer Center Records (SFPCR)

Forest History Society Archives, Durham, North Carolina

Society of American Foresters Collection (SAF)

Schmitter, Father Philip. Interview with the author, Flint, Michigan,
4 August 2015

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Published Sources

Adeola, F. O. "Environmental Hazards, Health, and Racial Inequity in Hazardous Waste Distribution." *Environment and Behavior* 26, no. 1 (1994): 99–126.

Araújo, Kathleen. "The Emerging Field of Energy Transitions: Progress, Challenges, and Opportunities." *Energy Research and Social Science* 1 (2014): 112–21.

Bradley, M. J., and Associates. "American Lung Association Energy Policy Development: Summary." Washington, DC: American Lung Association, February 2011.

Bullard, Robert. "The Threat of Environmental Racism." *Natural Resources and Environment* 7, no. 3 (Winter 1993): 23–26, 55–56.

Chavis, Benjamin, Jr., and Charles Lee. *United Church of Christ Commission on Racial Justice, Toxic Wastes and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites*. New York: United Church of Christ, 1987.

Cole, Luke W., and Sheila R. Foster. *From the Ground Up: Environmental Racism and the Rise of the Environmental Justice Movement*. New York: New York University Press, 2001.

Crosby, Alfred W. *Children of the Sun: A History of Humanity's Unappeasable Appetite for Energy*. New York: W. W. Norton, 2006.

Dandaneau, Steven P. *A Town Abandoned: Flint, Michigan, Confronts Deindustrialization*. Albany: State University of New York Press, 1996.

Davis, J. Michael, and David J. Svendsgaard. "Lead and Child Development." *Nature* 329 (September 1987): 297–300.

Dorka, Lilian S., Director, Civil Rights Compliance Office, EPA, to Heidi Grether, Director, MDEQ, 19 January 2017. Available at www.epa.gov/sites/production/files/2017-01/documents/final-genesee-complaint-letter-to-director-grether-1-19-2017.pdf.

Environmental Protection Agency, Environmental Administrative Decisions. "In the Matter of Genesee Power Station, PSD Appeal Nos. 93-1 through 93-7, Order denying review in part and remanding in part," decided 22 October 1993.

- “EPA Policy Questioned from the Start.” *Detroit News*, 28 December 1998, 13A.
- Executive Office of the President, Energy Policy and Planning. “The National Energy Plan.” US Government Printing Office, 1977.
- Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.” *Federal Register* 59, no. 32 (16 February 1994): 7629–33.
- Fiege, Mark. *Irrigated Eden: The Making of an Agricultural Landscape in the American West*. Seattle: University of Washington Press, 1999.
- Haraway, Donna. “A Cyborg Manifesto: Science, Technology, and Socialist Feminism in the Late Twentieth Century.” In *Simians, Cyborgs, and Women: The Reinvention of Nature*, 149–82. New York: Routledge, 1991.
- Hightsmith, Andrew R. “Demolition Means Progress: Urban Renewal, Local Politics, and State-Sanctioned Ghetto Formation in Flint, Michigan.” *Journal of Urban History* 35 (2009): 348–68.
- Hirsh, Richard. “Historians of Technology in the Real World: Reflections on the Pursuit of Policy-Oriented History.” *Technology and Culture* 52, no. 1 (January 2011): 6–20.
- Hirsh, Richard F., and Christopher F. Jones. “History’s Contributions to Energy Research and Policy.” *Energy Research and Social Science* 1 (2014): 106–11.
- _____, and Benjamin K. Sovacool. “Wind Turbines and Invisible Technology: Unarticulated Reasons for Opposition to Wind Energy.” *Technology and Culture* 54, no. 4 (October 2013): 705–34.
- Hughes, Thomas P. *Networks of Power: Electrification in Western Society, 1880–1930*. Baltimore: John Hopkins University Press, 1983.
- _____. “The Evolution of Large Technological Systems.” In *The Social Construction of Technological Systems*, edited by Wiebe Bijker, Thomas P. Hughes, and Trevor Pinch, 45–76. Cambridge, MA: MIT Press, 1987.
- Hurley, Andrew. *Environmental Inequalities: Class, Race, and Industrial Pollution in Gary, Indiana, 1945–1980*. Chapel Hill: University of North Carolina Press, 1995.
- Jasonoff, Sheila, and Sang-Hyun Kim. “Sociotechnical Imaginaries and National Energy Policies.” *Science as Culture* 22, no. 2 (2013): 189–96.
- Jones, Christopher F. *Routes of Power: Energy and Modern America*. Cambridge, MA: Harvard University Press, 2014.
- Kelly, Liam. “Environmental Justice Case Study: Incinerator in Flint, Michigan,” University of Michigan, 8 December 2000. Available at <http://umich.edu/~snre492/Jones/flint.htm>.
- Laidlaw, Mark A., Gabriel M. Filippelli, Richard C. Sadler, Christopher R. Gonzales, Andrew S. Ball, and Howard W. Mielke. “Children’s Blood Lead Seasonality in Flint, Michigan (USA), and Soil-Sourced Lead

OCTOBER
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VOL. 59

- Hazard Risks." *International Journal of Environmental Research and Public Health* 13, no. 4 (2016): 358.
- Laird, Frank. *Solar Energy, Technology Policy, and Institutional Values*. Cambridge, UK: Cambridge University Press, 2001.
- _____. "Constructing the Future: Advocating Energy Technologies in the Cold War." *Technology and Culture* 44, no. 1 (Jan. 2003): 27-49.
- Latour, Bruno. *We Have Never Been Modern*. Cambridge, MA: Harvard University Press, 1993.
- LeCain, Timothy J. *Mass Destruction: The Men and Giant Mines That Wired America and Scarred the Planet*. New Brunswick, NJ: Rutgers University Press, 2009.
- Lerman, Nina. "Categories of Difference, Categories of Power: Bringing Gender and Race into the History of Technology." *Technology and Culture* 51, no. 4 (October 2010): 893-918.
- Lerner, Steve. *Diamond: A Struggle for Environmental Justice in Louisiana's Chemical Corridor*. Cambridge, MA: MIT Press, 2004.
- Lovins, Amory B. "Energy Strategy: The Road Not Taken?" *Foreign Affairs* 55, no. 1 (October 1976): 65-96.
- _____. *Soft Energy Paths: Toward a Durable Peace*. New York: Harper and Row, 1977.
- Marx, Leo. *The Machine in the Garden: Technology and the Pastoral Ideal in America*. New York: Oxford University Press, 1964.
- McGurty, Eileen. *Transforming Environmentalism: Warren County, PCBs, and the Origins of Environmental Justice*. New Brunswick, NJ: Rutgers University Press, 2009.
- Melosi, Martin, and Joseph Pratt. *Energy Metropolis: An Environmental History of Houston and the Gulf Coast*. Pittsburgh: University of Pittsburgh Press, 2007.
- Merchant, Carolyn. "Shades of Darkness: Race and Environmental History." *Environmental History* 8, no. 3 (2003): 380-94.
- Michigan Department of Natural Resources, Air Quality Division. Activity Report: "Determination of Best Available Control Technology (BACT) for Lead Emissions," 20 November 1993.
- _____. Activity Report: Miscellaneous, 26 November 1997.
- Miller, Clark A., Alastair Iles, and Christopher F. Jones. "Social Dimensions of Energy Transitions." *Science as Culture* 22, no. 2 (2013): 135-48.
- Mittlefehldt, Sarah. "Seeing Forests as Fuel: How Conflicting Narratives Have Shaped Biomass Energy Development in the United States since the 1970s." *Energy Research and Social Science* 14 (2016): 13-21.
- _____, and Codie Tedford. "Benefit or Burden? Environmental Justice and Community-Scale Biomass Energy Systems in Vermont." *Environmental Justice* 7, no. 4 (2014): 110-14.
- Mohai, Paul, and Bunyan Bryant, eds. *Race and the Incidence of Environmental Hazards: A Time for Discourse*. Boulder, CO: Westview, 1990.

- Moss, Kary L. "Environmental Justice at the Crossroads." *William & Mary Environmental Law and Policy Review* 24, no. 1 (2000): 35–66.
- "Notice of Significant Industrial Pollution Violation." *Flint Journal*, 8 February 1998, E11.
- Ottinger, Gwen. "The Winds of Change: Environmental Justice in Energy Transitions." *Science as Culture* 22, no. 2 (2013): 222–29.
- Perlin, John. *Let It Shine: The 6,000-Year Story of Solar Energy*. Novato, CA: New World Library, 2013.
- Priest, Tyler R. *The Offshore Imperative: Shell Oil's Search for Petroleum in Postwar America*. College Station: Texas A&M University Press, 2007.
- _____. "The Dilemmas of Oil Empire." *Journal of American History* 99, no. 1 (June 2012): 236–51.
- "Principles of Environmental Justice." First National People of Color Environmental Leadership Summit, October 1991, Washington, DC.
- Pritchard, Sara B. *Confluence: The Nature of Technology and the Remaking of the Rhone*. Cambridge, MA: Harvard University Press, 2011.
- _____. "Joining Environmental History with Science and Technology Studies: Promises, Challenges, and Contributions." In *New Natures: Joining Environmental History with Science and Technology Studies*, edited by Dolly Jørgensen, Finn Arne Jørgensen, and Sara B. Pritchard, 1–17. Pittsburgh: University of Pittsburgh Press, 2013.
- Pursell, Carroll. "The History of Technology as a Source of Appropriate Technology." *Public Historian* 1, no. 2 (Winter 1979): 15–22.
- _____. "The Rise and Fall of the Appropriate Technology Movement in the United States, 1965–1985." *Technology and Culture* 34, no. 3 (July 1993): 629–37.
- Rose, Dietmar W. "Fuel Forest versus Strip-Mining: Fuel Production Alternatives." *Journal of Forestry* 73, no. 8 (August 1975): 489–93.
- Russell, Edmund, James Allison, Thomas Finger, John K. Brown, Brian Balogh, and W. Bernard Carlson. "The Nature of Power: Synthesizing the History of Technology and Environmental History." *Technology and Culture* 52, no. 2 (2011): 246–59.
- Sabin, Paul. *Crude Politics: The California Oil Market, 1900–1940*. Berkeley: University of California Press, 2005.
- Schot, Johan. "Confronting the Second Deep Transition through the Historical Imagination." *Technology and Culture* 57, no. 2 (April 2016): 446–47.
- Schumacher, E. F. *Small Is Beautiful: Economics as if People Mattered*. London: Blondie and Briggs, 1973.
- Shrader-Frechette, Kristen, and Whitney C. Pressier. "Renewable Technologies and Environmental Injustice: Subsidizing Bioenergy, Promoting Inequality." *Environmental Justice* 6, no. 3 (2013): 88–93.
- Smil, Vaclav. *Energy Transitions: History, Requirements, Prospects*. Santa Barbara, CA: Praeger, 2010.

- Smith, Kimberly K. *African American Environmental Thought: Foundations*. Lawrence: University Press of Kansas, 2007.
- Sorensen, Bent. "A History of Renewable Energy Technology." *Energy Policy* 19, no. 1 (1991): 8–12.
- Sovacool, Benjamin. "Rejecting Renewables: The Socio-technical Impediments to Renewable Electricity in the United States." *Energy Policy* 37 (2009): 4500–13.
- OCTOBER
2018
VOL. 59
- "Split Wood Not Atoms." *News-Messenger* (Fremont, Ohio), 19 October 1981, n.p.
- Stine, Jeffrey K., and Joel A. Tarr. "At the Intersection of Histories: Technology and the Environment." *Technology and Culture* 39 (1998): 601–40.
- Stobbe, Mike. "Planned Wood-burning Project Draws Fire." *Flint Journal*, 16 October 1992, B1, B4.
- _____. "Residents Take Last Shot at Halting Power Plant." *Flint Journal*, 22 December 1993, C1, C2.
- Tarr, Joel. "Transforming an Energy System: The Evolution of the Manufactured Gas Industry and the Transition to Natural Gas in the United States (1807–1954)." In *The Governance of Large Technical Systems*, edited by Olivier Coutard, 19–37. London: Routledge, 1999.
- Taylor, Dorceta. "The Evolution of Environmental Justice Activism, Research, and Scholarship." *Environmental Practice* 13, no. 4 (2011): 280–301.
- Turner, James M. "Following the Pb: An Envirotechnical Approach to Lead-Acid Batteries in the United States." *Environmental History* 20, no. 1 (2015): 29–56.
- Uekotter, Frank. "Fukushima, Europe, and the Authoritarian Nature of Nuclear Technology." *Environmental History* 17, no. 2 (April 2012): 277–84.
- United Church of Christ Commission on Racial Justice. *Toxic Waste and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites*. 1987.
- United States Forest Service. "Successful Approaches to Regulating Wood Waste," FPL-GTR-133, October 2001.
- Ward, Brandon. "The Promise of Jobs: Blackmail and Environmental Justice in Flint, Michigan, 1991–1995." *Environmental Justice* 6, no. 5 (2013): 163–68.
- Webber, Tammy. "Area Activists Get Pointers from Veteran of Love Canal." *Flint Journal*, 2 December 1995, C1.
- White, Richard. *The Organic Machine: The Remaking of the Columbia River*. New York: Hill and Wang, 1996.
- Wickham, Tom. "'Environmental Justice' Dispute Harmful—Engler." *Flint Journal*, 11 November 1998, A8.
- Winner, Langdon. *The Whale and the Reactor: The Search for Limits in an Age of High Technology*. Chicago: University of Chicago Press, 1986.