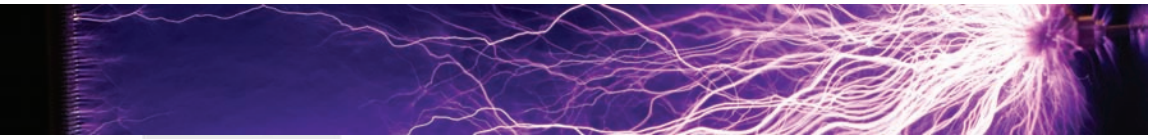
CULTURAL ANTHROPOLOGY

Openings and Retrospectives



AN ANTHROPOLOGY OF ELECTRICITY FROM THE GLOBAL SOUTH

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While completing my PhD at Stanford University during the 1980s, I was able to support my doctoral studies with a part-time job at the Electric Power Research Institute (EPRI). I worked at EPRI both before and after my anthropological fieldwork in an Indian village. As a consortium funded largely by electric utilities, EPRI's charge was to take the industry's pooled resources, fund research on specific issues important to electrical utilities, and then feed the research results back to the utilities in order to improve generation, transmission, distribution, and end use. Thirty years ago, EPRI was funding research that has only today become reality, like electric cars, or that is still not in common use, like smart meters, smart homes, the smart grid, and appliances that "talk back" to the grid and adjust their power usage.

In some sense, then, I am returning full circle in this essay to ask a question that I never thought important while I was working in the electrical power industry: What can anthropology contribute to the study of electricity, and what can electricity contribute to the study of anthropology? Why do we need an anthropology of electricity?

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Of all the forms of energy that fuel our modern world and its lifeways, electricity is perhaps the most pervasive and also the most interesting. More than other infrastructure, the ubiquity of electricity may indeed have hindered an appreciation of its biopolitical importance. Timothy Mitchell (2011, 12–42) has urged social scientists to pay greater attention to the specific material properties of fossil fuels, properties that shape the manner in which these fuels can be stored, transported, and used. Electricity is unlike petroleum, coal, or wood in that it is not itself a form of stored hydrocarbon energy. It has no existence in nature. Rather, it is a purely artificial form of energy that can be produced from diverse sources like hydropower, nuclear fuel, or solar power. Compared to petroleum or coal, it is relatively easy to transport and transmit across vast distances through wires. Unlike those other fuels, it is lost during transmission, and the greater the distance that it has to be transported, the greater the losses. Another very important feature of electricity is that the technology to store large quantities of it effectively does not yet exist.[1] The production and use of electricity thus have to be carefully synchronized: any mismatch between supply and demand creates problems, from potential grid instability to inconvenience for the end user.

Other properties of electricity are important: unlike fossil fuels, electricity is an immaterial object. It cannot be seen, smelled, or heard, and for all practical purposes, it cannot be tasted or touched without lethal consequences. There is thus no sensual way to experience electricity. Of course, we can see the plants where it is generated, the wires through which it is carried, the appliances or machines that make use of it, and the effects it has on the body. Electricity is always mediated, and thus is from the very beginning a social and cultural thing, not something that belongs to the natural world, however that might be construed. As such, the word *electric* itself arises from science experiments around 1625; it has no Greek or Latin etymology.

There are two other features of electricity to which I want to draw attention. The first is that it is a historically young form of power. Thus, when in 1894, Friedrich Engels complains about the difficulty of taking up his pen in "artificial light" (Marx 1981, 91), he is talking about a relatively recent phenomenon.[2] Secondly, this historical footnote also draws attention to the fact that electricity gained a decisive advantage over other forms of power mainly through the advantages it provided for lighting. Internal combustion engines fueled by oil and coal continued to supply most machines and cars with power, and residential and office spaces were largely heated by burning fossil fuels. But lighting was an area where electrical power had a clear advantage: it supplied steady luminescence

without generating noxious fumes or creating a fire hazard. Electric lights opened up a "second day" for consumption, recreation, and schooling (through homework), made it much safer to illuminate tight urban spaces and the interiors of homes, enabled public spaces to be safer and more family-friendly (Nye 1999; Winther 2008; Pereira et al. 2011), and by opening up extra hours after the sun had set for domestic life, enabled longer working hours on the factory floor. Electricity also enabled shiftwork, such that production units could be open twenty-four hours a day, facilitating the manufacture of goods and the turnover of capital (Woolf 1984).

When they are functioning as intended, infrastructures tend to disappear into the background: they become invisible. In homes, pipes carrying water, waste, electrical wires, and phone and telecommunication wires are all hidden inside walls; in cities, these infrastructures are often hidden under streets. They become visible only when they break down—when the walls have to be broken because of a leaking pipe, or when roads have to be dug up to install new high-speed telecommunication cables. Unlike consumer objects like cars, refrigerators, and television sets, infrastructures are not intended to be displayed and aestheticized.[3] Infrastructures have been critical to the biopolitical project of managing the welfare of the population, especially in the global North, and yet they have been completely invisible to the population being managed and largely neglected by social scientists studying the management and control of populations.

In this regard, electricity is a typical infrastructure—electrical wires are usually hidden in homes, while electrical and telephone poles are increasingly being replaced by underground connections in cities. But what makes electricity different from other infrastructures is its role in lighting. The centrality of lighting has meant that the biopolitical project has been especially visible in the form taken by electricity infrastructures. Lighting helped to realize a certain vision of private life by enabling the particular form of domesticity found in the nuclear family, centered around the extension of the school day through homework, the making and consumption of family meals, the supply of entertainment and leisure through radio, television, and magazines, and the regulation of fertility implied by all of those activities (Wilhite 2012; Peters and Vance 2011). Thanks to lighting, non-productive activities relating to relaxation, rest, and reproduction were pushed into the margins of the day (Winther 2008). There was life after dark and it could be devoted to useful activity, even if that activity was not related to work. Lighting also permitted the use of public spaces after sunset. Thus, street lighting and the lighting of public squares allowed those spaces to become safer for families to

traverse, extending possibilities for shopping and consumption, mass entertainment, and public and private transportation (Pereira et al. 2011; Jacobson 2007).

Lighting, in turn, led to the use of electricity for a whole range of domestic appliances, from toasters and vacuum cleaners to washing machines, stoves, and ovens. Once people were connected to the grid, the focus of utilities was on ensuring that there was adequate supply, since demand seemed to grow endlessly due to new uses for electricity.[4] The more electricity became part of the lives and lifestyles of consumers, the greater the emphasis on its quality, reliability, and uninterruptedness. The norm for electric supply in the West became continuous, reliable power, twenty-four hours a day.

LIVING IN THE DARK

The normative in social science is often that which is presupposed, rather than being manifest in consciously held beliefs and explicit evaluations about what is good and bad. In the case of electricity, the normative is smuggled in through the idea that all individuals should be connected to a grid, which supplies them with a continuous flow of electricity. So much is it taken for granted among "us moderns" (Latour 1993) that people will be connected to the grid, the larger question about why it is desirable is not up for discussion. Even from a radical environmental perspective on climate change and the Anthropocene, the necessity and desirability of life on the grid are seldom questioned.

What would it be like to live in the dark? The only experience most people have of life off the grid is when they go camping, ironically to regenerate their senses and bodies after getting used to the comforts of modern, urban life, made possible in part by electricity. In the mid-1980s, I lived in a small village in Uttar Pradesh in northern India where homes had not been connected to the grid. In official parlance, the village had been "electrified," which conveyed the image of being jolted into modernity. In reality, though, the wires reached only the tube wells in the fields, not the homes of villagers.[5] There were no streetlights, and the few television sets found in the village drew power from diesel generators.

In most development trajectories, the absence of electricity would be seen as a source of deprivation. Yet the lack of electricity in this village was conducive to the creation of a lively social and political sphere. After dark, once all of the day's chores were done and before going to sleep, there was time for amiable sociability. Small groups of men would gather on the porches of homes, while women would gather at each other's homes, exchanging information, gossip, and news. Children would play in the streets. The whole village was abuzz with

sounds. With no other entertainment and with no light to elongate the working day, this time was spent in creating and maintaining a public sphere. The darkness, paradoxically, enabled a sense of community to be built in the village. The contrast with larger villages that did have electricity was striking: there, people retreated to their own homes and were entertained by (centrally controlled) television and radio.

A young man explained to me how much he had hated life in the city where he had gone to live with a relative. "Here," he said, "if you want to meet a young woman discreetly, you just step off the main road leading to the village, and you have all the privacy you need. In the city, there are lights everywhere, and you dare not speak to a young woman without everyone coming to know, and gossip spreading like lightning." Far from seeing electricity as a form of liberation, some villagers experienced it as increasing the possibilities of surveillance and control. However, I do not want to give the impression that living in the dark was a positive feature of social life for all segments of the population. For example, when women had to go out to the fields at night to irrigate fields or to defecate, they faced an increased risk of sexual violence. The darkness hid the trysts of lovers, but it also hid forms of gendered violence that made everyday life much more difficult for women.

If a village was electrified, government statistics recorded all of the people who lived there as having access to electricity, and by this measure almost all of India had electricity. However, a new method of calculating access based on household-level data discovered that more than three hundred million people in India had no electricity, more than any other nation-state in the world. For a large share of India's population, life off the grid was the normal condition of everyday life.

However, even those on the grid seldom had electricity. Being connected to the grid and having electricity are two different issues. In a typical day, most rural consumers who were on the grid received power for a few hours. To refer to the period of no power as a blackout or brownout makes little sense when the lack of power constitutes the major part of the day, unless one assumes a baseline of uninterrupted power for everyone. Since the majority of Indian consumers have never had access to uninterrupted power, its presence, not its absence, is what would surprise in the Indian context. Many Indians were mystified when a blackout in 2003 in the eastern United States, including New York, made front-page news. They could not understand why people were so exercised over not

having power for a couple of days, and what exactly was newsworthy about something that, to them, was an everyday occurrence.

What this makes clear is that although the focus of government policy and popular perception is on whether people are connected to the grid, this fact alone is less important than the quality of electricity to which people have access. Quality refers to reliability, but also to whether the current can be maintained within strict limits. One may have electricity, but if the power keeps tripping every few minutes, it may ruin appliances connected to the grid and may prevent one from operating electrical stoves to cook dinner or using washing machines to clean clothes. The introduction of mass electronic consumer goods forced electrical utilities in the global North to focus on the quality of power, which meant keeping variation and fluctuations in the quality of electricity within very tight parameters.

Years after my village fieldwork, when I was living in a small town in Uttar Pradesh and doing research on state development bureaucracies, the variability of power remained noticeable. As soon as dusk approached, the voltage would drop alarmingly. Hundred-watt light bulbs would glow as feebly as candles, and tube lights stopped working altogether. The elements in the electric heaters that I used to keep warm were barely visible. Around ten at night, when the illegal connections that people used to tap into the main to draw electricity for cooking and other activities were no longer drawing power, the voltage would shoot up. The same light bulbs that had barely been emitting light became blindingly bright and frequently burned out due to the excessively high voltage. The same heaters would provide plenty of heat for the night.

POWER TO THE PEOPLE?

Why were people in Uttar Pradesh tapping into the electric mains illegally? More importantly, why were they allowed to tap into the mains without the fear of official retaliation? The relationship between electric power and the poor is a particularly vexed one for states in the global South. The problem is compounded by corruption, which muddies the water as to who is using electricity illegitimately without paying for it.

As Antina von Schnitzler (2013) shows in her study of prepaid meters in South Africa, while connecting all citizens to the grid might be an index of the modernity of the nation-state, the problem remains how poor people can afford to pay for this relatively expensive product. In a highly stratified society like South Africa, the result has been paradoxical. On the one hand, post-apartheid govern-

ment policy has promoted access for everyone, especially for poor people living in townships and homelands. On the other hand, neoliberal government policy has prevented a more vigorous redistributive agenda. Many poor Africans who were off the grid now have access to electricity, but do not have the money to pay for its use. The only way to benefit from a good that has supposedly been provided to them is to doctor the meters so that they can use electricity for free. However, the state utility considers this to be cheating and has invented prepaid meters that cut off supply if the consumer cannot pay for electricity. Thus, we arrive at a paradoxical situation where the poor are connected to the grid, but cannot use electric power. Modernity has arrived without delivering on its promise: it has not made the lives of the poor easier. Moreover, people may end up paying a significant proportion of their income for a good that is considered a basic right for a citizen of a modern nation-state.

For very different reasons, a similar situation exists for poor people in urban and rural India. Since the large majority of the urban poor live in unauthorized settlements—that is, slums—they cannot officially be granted electrical connections. Once such connections are officially granted, they can be leveraged to prove residence and thereby to convert unauthorized hutments into legal occupancy. Therefore, power companies refuse to give official connections to residents of slums. However, they recognize that people need electricity to live in an urban environment. Thus, they unofficially allow slum residents to tap into power lines. Politicians, police, and bureaucrats are all complicit in this lawbreaking, going so far as to collect rent from residents for unauthorized access to electricity. For their part, residents do not pay for the electricity they use, even if they pay an equivalent amount in bribes. Playing on the different meanings of the term, the urban poor can thus be said to have *precarious power*.[6]

For the rural poor, the situation is very different. Power in India is controlled not by the federal or central government, but by the twenty-nine individual state governments (Kale 2014). Electoral competition, populist politics, and the organizational abilities of rich peasants have made the provision of free power an important electoral platform. However, providing free power to farmers has many undesirable consequences, apart from its impact on the bottom line of power companies. It encourages farmers to pump groundwater excessively, leading to a lowering of the water table. It encourages them to grow water-hungry crops even in arid environments. And it increases inequality in rural areas, because richer farmers are able to afford the cost of tube wells and pumps more easily. Since power companies cannot afford to supply electricity around the clock for

free, they regulate demand by shutting off supply. As a consequence, most people in rural areas receive electricity for only a few hours every day, if at all, and the supply is in most cases erratic and unpredictable.

Most states began by charging farmers a flat fee for electricity that was indexed to the size of the motor being used in their tube wells. However, the trend in recent years has been away from collecting even that nominal sum. So, because farmers are not charged for electricity, most state electricity boards have simply stopped measuring how much electricity is lost. This practice, in turn, makes it impossible to estimate how much of the power that is lost is given away and how much is stolen.

The reason why this practice is important is that on average, 40 percent of the power produced in India cannot be accounted for (Bhalla 2000), and is presumed lost or stolen. Transmission losses are a well-known property of electricity, but comparing India to other countries—where transmission losses are less than 10 percent—makes it clear that massive quantities of electricity are being stolen. Not counting how much power goes to rural areas enables utilities to mask other forms of stealing under the convenient rubric of free power to farmers. In fact, we do not know how much power is stolen through the connivance of utility officials and politicians colluding with industrial users. In exchange for bribes, companies can be underinvoiced for their power consumption and overcompensated for any "excess" power that they put into the grid from their own captive power plants.

THE ANTHROPOLOGY OF ELECTRICITY

I want to come back to a question that I posed at the beginning: Why is an anthropology of electricity important now? And why are such studies particularly critical in the global South? In the Anthropocene, the issue of how we use energy is one of the central questions facing humankind. Which energy sources we use and how much we use will determine the rate of climate change. Since the fastest growth of demand is due to consumers in the global South who are becoming middle-class, it will be particularly important to understand what states in the global South are doing to produce and consume energy. As social scientists, we know almost nothing about what consumers in the global South are doing with energy: what sources of energy they use in daily activities, what they use them for, how, when, and why they switch from one source to another, and so on.[7] Electricity is particularly important because it is seen as clean and modern, and

because it mitigates existing local air pollution caused by the use of petroleum, kerosene, and wood for transportation, cooking, and heating.

The anthropology of electricity can help us understand the relationship between sources of energy and social and political arrangements, as Timothy Mitchell (2011) suggests. How electricity is generated, transmitted, distributed, and consumed is fashioned by existing social arrangements, but also profoundly shapes political and social structures (Shamir 2013). Following Mitchell, it is important to pay attention to the specificity of the properties of electricity to see how it has altered and reinforced existing hierarchies and inequalities in institutions and practices. The fact that electricity can be transmitted easily over vast distances, the fact that it cannot be stored easily, and the fact that supply and demand have to be instantly coordinated have profound implications for electricity's dialectical relationship to social infrastructures and political institutions.[8]

Energopolitics is also closely linked to biopolitics (Boyer 2014). The manner in which electricity is generated and distributed has a profound impact on daily life. With the availability of affordable electricity, new consumer desires arose and new forms of consumption became available. Starting with lighting, the radio, and the electric iron, a whole host of new appliances made their way into people's homes and lives. As the supply of electricity became more predictable and its quality more reliable, new consumer goods began to compete for the attention of consumers. In urban India in the 1970s, the only electrical appliances in many middle-class homes were mixers, irons, sewing machines, heating coils for hot water, and—for the upper segments of the middle class—refrigerators and a window air conditioner in the bedroom. Since then, hot water tanks or geysers have become commonplace, but so have refrigerators, microwave ovens, television sets, air conditioners, washing machines, and computers. The supply of electricity is unable to keep up with demand, and there is a persistent shortfall of approximately 11 percent at peak power (CEA 2012).

The biopolitical uses of electricity—its role in lighting streets and homes, in creating and regulating the desire for commodities involved with entertainment and domestic work, in shaping design and architecture by heating and cooling indoor spaces, in making life more comfortable for the population—have received almost no attention in anthropology and thus constitute a fecund subject for future research. So much of the lives of people around the world is shaped by infrastructure and its absence or partial presence—for example, getting a few hours of electricity or water a day—and almost all of it has escaped the attention of social scientists. Our accounts of the everyday lives of people in the global South are

incomplete because they do not pay attention to the different ways in which people encounter the partial presence of modern infrastructure.

ELECTRIC FUTURES

The dystopian future embodied in the eco-suicidal age of the Anthropocene makes it clear that nation-states in the global South cannot emulate the developmental trajectory of the global North. Furthermore, it is equally clear that nation-states in the global North cannot continue on the trajectories they have followed until now. For both the global South and the global North, the past is not a good guide to the future. More importantly, futures past are of little help in thinking about the future in the present (Koselleck 2004). The problem of sustainable futures requires a complete recalibration of energy use with social and political life.

We thus have to reimagine electricity use in the future that does not simply seek to extend the patterns of the present. Bringing more people to the grid so that they can consume more electricity is neither feasible nor desirable. Yet this is precisely what so many solutions to climate change seek to do. Generating and using more electricity is taken as a foregone conclusion: the question is merely how to do it with the least impact on the environment. It is for this reason that nuclear power has once again found favor with many policymakers, despite the unresolved question of how to dispose of nuclear waste.

I want to be clear that I do not think people in the global South who are rapidly joining the ranks of the middle class should not be allowed to do so. Rather, the real question is how the quality of people's lives in the global South can be improved, not by emulating the destructive patterns of the global North, but by pursuing new, sustainable developmental paths that have not yet been taken. There is a real opportunity to leapfrog the carbon economy and life on the grid to establish future-oriented, sustainable ways of living.

What are other possible electric futures? As a latecomer to development, the global South can become a model for the rest of the world by experimenting with different ways of using electricity. It is a fact that the grid still does not reach many people in the global South, and that many areas of the world are not connected to a central system of electric power. Could one take advantage of this "disability," and instead of expending enormous resources in connecting people to a central grid, experiment with using distributed sources of energy rather than concentrated ones, living off the grid completely, or relying on local networks of power-sharing in the form of small-scale grids? One of Mahatma Gan-

Figure 1. Stitching under smart power lamp. Photo by Robin Wyatt, used here courtesy of the Rockefeller Foundation.

dhi's critiques of electrical power was the worry that it would bring centralized control over the lives of people in remote villages and prevent communities from becoming self-sufficient for their energy needs (Kale 2014, 28). A combination of wind, solar, biomass, and electric power could meet all of a community's energy needs and, whether we like it or not, that is the future of energy sustainability on the planet, since we cannot continue to burn the energy stored inside the earth. In most cases, people who are off the grid are already living sustainable lives, although this is not universally the case.[9] The question is how new technologies can make the quality of life higher without reproducing the steps taken by the growth of the carbon economy, and the forms in which electricity has been historically incorporated into the lives of people.

The first step towards such a model of sustainable energy use is to match the quality of energy to its end use. The availability of cheap electricity has led to its misuse. It is thermodynamically inefficient to convert low-quality forms of energy like solar and wind power into electricity and then to use that electricity for low-quality uses such as heating, cooling, and cooking. Electricity is needed for very few functions and, by carefully matching energy quality to use and through better demand-side management, a high quality of life could be attained with a fraction of the energy that we use today.

What is at stake here are different ideas about the future. That the aspiration of the emerging middle class in the global South is to become more like the rich citizens of the global North is an index of the colonization of their imaginations of the future. The failure of development discourse lies in the fact that it seeks to replicate globally the condition of the global North, even as it is increasingly evident that such a condition is unsustainable and leads to eco-suicide. Gandhi was prescient about the unsustainability of modern developmental models when he reportedly said: "If it took Britain half the resources of the world to be what it is today, how many worlds would India need?" (Tolba 1987, 118)[10] Electric futures have to contend with these aspirations among the emerging classes in the global South and struggle to realize notions of development and progress that are sustainable.

NOTES

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1. Battery storage technology is improving rapidly, and Tesla's recent announcement of a battery that will store enough power to supply a home's energy needs in the evenings promises to have an impact on electric end-use patterns.
2. By 1898, only 5 percent of U.S. households had electricity. According to David Nye (1999, 166), "the major shift to electricity in the home occurred between 1915 and 1929."
3. The exceptions here would be transportation infrastructure such as bridges, railway tracks, subway and railway stations, buses, and trains, which, despite their visibility, are often not subject to aesthetic refinement.
4. Historically, utilities in the United States did not worry about demand. It was assumed that demand would grow at a steady pace, and the problem was always how to ensure that there was enough supply of electricity—that there were enough power plants to generate the energy that was needed by industrial and residential consumers.
5. Tube wells are small-bore pipes that are powered by electric pumps and used to draw water from the ground. When I started my fieldwork in 1984, the pipes had to be sunk just thirty feet to reach the water table.
6. Access to other infrastructures, such as water and sanitation, is equally precarious. Unlike water or electricity, the problem of sanitation is not easily solved and leads to intolerable situations for poor people.
7. The work of Tanja Winther (2008) in Zanzibar and Harold Wilhite (2012) in Kerala are notable exceptions.
8. Ronen Shamir (2013, 6), for example, writes that "the grid is a maker of groups and a generator of political and economic difference among groups and individuals."
9. Sunila Kale (pers. comm.) has pointed out that people dependent on firewood may, in fact, be employing unsustainable sources of fuel. Firewood and cow dung cakes used for cooking in many parts of rural India emit particulate matter and smoke that constitute real dangers to women's health.
10. Tolba does not give us a citation from Gandhi's writings; see Ramachandra Guha (2006, 231) on the quotation's provenance.

REFERENCES

Bhalla, M.S.
2000 "Transmission and Distribution Losses (Power)." Proceedings of the National Conference on Regulation in Infrastructure Services. New Delhi: Energy and Resources Institute. http://www.teriin.org/upfiles/pub/papers/ft33.pdf

Boyer, Dominic
2014 "Energopower: An Introduction." *Anthropological Quarterly* 87, no. 2: 309–33. http://dx.doi.org/10.1353/anq.2014.0020

Government of India Central Electricity Authority (CEA)
2012 "Performance Review of Thermal Power Stations, 2011–12," accessed August 12, 2015. http://www.cea.nic.in/reports/annual/thermalreview/thermal_review-2011.pdf

Guha, Ramachandra
2006 *How Much Should A Person Consume? Environmentalism in India and the United States*. Berkeley: University of California Press.

Jacobson, Arne
2007 "Connective Power: Solar Electrification and Social Change in Kenya." *World Development* 35, no. 1: 144–62. http://dx.doi.org/10.1016/j.worlddev.2006.10.001

Kale, Sunila S.
2014 *Electrifying India: Regional Political Economies of Development*. Stanford, Calif.: Stanford University Press.

Koselleck, Reinhart
2004 *Futures Past: On the Semantics of Historical Time*. Translated by Keith Tribe. New York: Columbia University Press. Originally published in 1979.

Latour, Bruno
1993 *We Have Never Been Modern*. Translated by Catherine Porter. Cambridge, Mass.: Harvard University Press.

Marx, Karl
1981 *Capital: A Critique of Political Economy*, vol. 3. Translated by David Fernbach. Originally published in 1894.

Mitchell, Timothy
2011 *Carbon Democracy: Political Power in the Age of Oil*. London: Verso Books.

Nye, David E.
1999 *Consuming Power: A Social History of American Energies*. Cambridge, Mass.: MIT Press.

Pereira, Marcio Giannini, José Antonio Sena, Marcos Aurélio Vasconcelos Freitas, and Neilton Fidelis da Silva
2011 "Evaluation of the Impact of Access to Electricity: A Comparative Analysis of South Africa, China, India and Brazil." *Renewable and Sustainable Energy Reviews* 15, no. 3: 1427–41. http://dx.doi.org/10.1016/j.rser.2010.11.005

Peters, Jorg, and Colin Vance
2011 "Rural Electrification and Fertility: Evidence from Côte d'Ivoire." *Journal of Development Studies* 47, no. 5: 753–66. http://dx.doi.org/10.1080/00220388.2010.527954

Shamir, Ronen
2013 *Current Flow: The Electrification of Palestine*. Stanford, Calif.: Stanford University Press.

Tolba, Mostafa Kamal
1987 *Sustainable Development: Constraints and Opportunities*. Guildford, U.K.: Butterworth Scientific.

von Schnitzler, Antina
2013 "Traveling Technologies: Infrastructure, Ethical Regimes, and the Materiality of Politics in South Africa." *Cultural Anthropology* 28, no. 4: 670–93. http://dx.doi.org/10.1111/cuan.12032

Wilhite, Harold
2012 "A Socio-Cultural Analysis of Changing Household Electricity Consumption in India." In *Tackling Long-Term Global Energy Problems, Environment and Policy: The Contribution of Social Science*, edited by Daniel Spreng, Thomas Flüeler, David L. Goldblatt, and Jürg Minsch, 97–113. Dordrecht: Springer.
Winther, Tanja
2008 *The Impact of Electricity: Development, Desires and Dilemmas*. New York: Berghahn.
Woolf, Arthur G.
1984 "Electricity, Productivity, and Labor Saving: American Manufacturing, 1900–1929." *Explorations in Economic History* 21, no. 2: 176–91. http://dx.doi.org/10.1016/0014-4983(84)90024-X