State of the World 2013

IS SUSTAINABILITY *Still Possible?*

THE WORLDWATCH INSTITUTE

CHAPTER 14

Keep Them in the Ground: Ending the Fossil Fuel Era

Thomas Princen, Jack P. Manno, and Pamela Martin

Coal, oil, and gas—fossil fuels: we can't do without them. They are the lifeblood of modern industrial civilization. These highly concentrated, widely available stores of energy have unleashed modern civilization's astonishing productivity, liberating billions of people from drudgery and insecurity. Finding more fossil fuels and getting them to markets around the world is the challenge of our times.

Fossil fuels: we must do without them. They feed the fire in the oven destined to bake civilization beyond recognition. When these hydrocarbons from the concentrated, pressurized remains of ancient organisms are burned, they overwhelm the Earth's ecosystems and condemn billions of people to climate-induced misery. Shifting to renewable energy sources and alternative ways of life is the challenge of our time.

Two existential positions, poles apart. Both may be accurate. The contradiction is the crux of the contemporary energy and environment dilemma and one reason governments have done so little in the face of obvious and ramifying threats.

Is there a way out? Not as long as technological optimism and trust in the magic of "the market" sustain the belief that the growth-dependent, consumerist, debt-laden, risk-accumulating world is the best of all possible worlds. Not when those who live in this world and those who aspire to join it see no reason to exchange the current model for an uncertain new model. Not when leaders and citizens alike cannot imagine replacing the current, fossil-fuel-dependent economic and social system. Why? Because too many people believe that the next energy transition, like previous transitions—from human power to animal power, animal to wood, wood to coal, and coal to oil—will make life better for all. As happened before, they believe, the next energy source will spur convenience, higher speeds, greater labor productivity, and more consumer choice—material progress forever. The bridge, this view has it, is new technologies to extract and burn every last bit

Thomas Princen is a professor of natural resources and environment at the University of Michigan. **Jack P. Manno** is a professor of environmental studies at SUNY College of Environmental Science and Forestry. **Pamela Martin** is a professor of politics at Coastal Carolina University.

of affordable oil, coal, and gas. This is the dominant worldview, what we dub the "industrial progressive" view.[1]

It is time to choose a different view and a different future. A first step is to recognize that Earth's "gift" to humanity of high-quality fossil fuels, those that pack the greatest energy wallop, is a one-time nonrenewing and diminishing reserve. There was a "before" (before the late nineteenth century), when fossil fuels powered only a tiny proportion of the world's work, and there will be an "after," when fossil fuels are reserved for tasks for which they, and they alone, are best suited. The question humanity faces at this historic juncture is how to navigate the transition, and how to do so given that the fossil fuel era will end and these fuels will be rationed—although on the current path, not soon enough to avert catastrophic climate and other environmental and social impacts.

The choice to keep fossil fuels in the ground in the face of otherwise overwhelming pressures to exploit them to the end is, we have come to believe, the only way to ensure that greenhouse gases and other pollutants remain out of the atmosphere and out of our bodies. The power and momentum of the fossil fuel complex is simply too great. And the predominant approach to ground-level air pollution, high-level climate change, and petrochemical contamination of human beings and nonhumans—that is, to manage fossil fuel emissions—is too ineffectual, too much of an accommodating, end-of-pipe approach. All too often, such an approach reduces a couple of centuries of history to one chemical element, carbon, when the real problem is upstream, in a global infrastructure and power structure that is extremely adept at drilling holes, blasting mountains, and laying pipes.

The Problem: Extraction . . . Not Emissions, Fossil Fuels . . . Not Carbon

The central problem is not emissions, but extraction. Put differently, it is not about carbon dioxide but fossil fuels—not about what comes out of the exhaust pipes and smokestacks but what comes out of the ground. To direct political attention away from end-of-pipe management to extraction is to be precautionary, a widely accepted approach for known toxic and ozone-depleting substances but not, as yet, for fossil fuels.

A carbon focus is reductionist, possibly the greatest and most dangerous reductionism of all time: a 150-year history of complex geologic, political, economic, and military security issues all reduced to one element—carbon. This framing implies that the problem only arises once fuels are burned. It effectively absolves of responsibility all those who organize to extract, process, and distribute. It leaves unquestioned the legal requirement to extract created by the selling of fossil-fuel reserves in futures markets and the widespread use of reserves for collateral in financial transactions. So con-

structed, extraction is called "production," and the burden of harm and of responsibility for amelioration falls on governments and consumers rather than on extractors. Inside the carbon logic, extraction is presumed to be a given—normal, inevitable, even desirable. What is more, the carbon lens portrays the global ecological predicament as one-dimensional: deal with carbon emissions, and everything else will follow.

To focus on fossil fuel extraction, in contrast, is to ask how and why removal of these fuels is deemed inevitable and net beneficial. A fossil fuel focus does not take such how-and-why questions as self-evident (people want the energy, producers get it). It directs analytic and political attention upstream to a whole set of decisions, incentives, and institutions that conspire to bring to the surface hydrocarbons that otherwise sit safely and permanently in the ground. It forces us to consider that once fossil fuels are extracted, their by-products—ground-level pollution, atmospheric greenhouse gases, petrochemical endocrine disruptors—inevitably and unavoidably move into people's bloodstream, into ecosystems, and into the atmosphere and oceans.

To question extraction is to consider deliberately limiting an otherwise valuable resource, rationing and setting priorities for its uses. It is to take renewable energy, conservation, equity, and environmental justice seriously and to create the institutions, local to global, capable of doing so. It is to ask what the prior ethics of fossil fuel allocation have been and what, given the imperative to reverse course and build a sustainable society, they must be. It is to ask what a politics of fossil fuel resistance and abolition would be and to imagine a deliberately chosen post–fossil fuel world.

All this leads to the conclusion—unthinkable for fossil fuel proponents and business-as-usual-only-greener proponents—that the only realistic means of stopping fossil fuel emissions is to keep the fuels in the ground. The only safe place for fossil fuels is in place, where they lie, where they are solid or liquid (or, for natural gas, geologically well contained already), where their chemistry is mostly of complex chains, not simple molecules like carbon dioxide, that find their way out of the tiniest crevices, that lubricate tectonic plates perpetually under stress, that react readily with water to acidify the oceans, and that float into high places filtering and reflecting sunlight, heating beyond livability the habitats below.

And yet the fossil fuel complex is extremely powerful. That power is at once energetic, economic, and political. Its weakness is ultimately geologic and ethical.

Fossil Fuel Influence

One measure of the industry's influence is the fact that 88 percent of the world's energy comes from fossil fuels. (See Box 14–1.) Sixty-one percent of that is produced by national oil companies—created, subsidized, and defend-

Box 14–1. Fossil Fuels by the Numbers

- Fossil fuels provide 88 percent of the world's energy.
- Fossil fuel infrastructure occupies an area the size of Belgium.
- Biofuel infrastructure roughly the size of the United States and India would be needed if biofuels were to replace fossil fuels.
- To meet industry and agency projections of increased energy demands, $38 trillion in oil and gas infrastructure is needed by 2035.
- It takes 7.3–10 calories of energy input to produce 1 calorie of food energy.
- Direct fuel subsidies to agriculture in the United States total $2.4 billion.
- Proven fossil fuel reserves, owned by private companies, state companies, and governments, exceed the planet's remaining carbon budget (in order to keep within a 2 degree Celsius temperature increase) by a factor of five.
- Occupationally related fatalities among workers in the oil and gas extraction process are higher than deaths for workers from all other U.S. industries combined.

Source: See endnote 2.

ed by national governments. Another is that the petroleum industry is the world's largest, capitalized at $2.3 trillion and accounting for 14.2 percent of all commodity trade. What's more, it is by far the most capital-intensive industry—$3.2 million is invested for every person employed. By comparison, the textile industry is capitalized at $13,000 per worker, the computer industry at $100,000, and the chemical industry at $200,000. And the petroleum industry is among the most profitable. In 2008, for example, ExxonMobil made $11.68 billion in second-quarter profits, amounting to profits of some $1,400 per second, and it ranked forty-fifth on a list of the top 100 economic entities in the world, a list that includes national governments. In 2010, ExxonMobil jumped to thirty-fifth on the list, just behind Royal Dutch Shell.[2]

Yet another indication of the influence of the fossil fuel complex is the flow of tax dollars to and from the industry. Worldwide, governments subsidize the fossil fuel industry to the tune of some $300–500 billion per year. In the United States in 2008, the petroleum industry paid $23 billion in royalties to the U.S. Treasury. In Saudi Arabia, the world's largest oil producer, oil and gas account for 90 percent of the gross domestic product while employing only 1.6 percent of the active labor force.[3]

Perhaps the industry's greatest source of influence is its ability to advance a vision, one of abundant and cheap energy, of powering and defending nations, of feeding and sheltering billions of people. It is a vision with appeal to nearly every sector of a modern industrial society—manufacturers, investors, military and political leaders, consumers. But its appeal has begun to erode.

For one, under the rubric of the "resource curse" (broadly construed), the social and economic costs have become well established. "The irony of oil wealth," writes political scientist Michael Ross in *The Oil Curse*, is that "the greater a country's need for additional income—because it is poor and has a weak economy—the more likely its oil wealth will be misused or squandered. . . . Since the oil nationalizations of the 1970s, the oil-producing countries have had less democracy, fewer opportunities for women, more frequent civil wars, and more volatile economic growth than the rest of the world, especially in the developing world." In addition, Ross finds, "by 2005,

at least half of the OPEC countries were poorer than they had been thirty years earlier."[4]

From a national security perspective, former CIA director Jim Woolsey says: "It was obvious that oil was dominant in a lot of places that generated trouble. There's almost nothing that doesn't get better if you move away from dependence on oil." Even industry insiders have taken stock and are trying to imagine a different world. "The resources are there," writes John Hofmeister, former president of the Shell Oil Company in the United States. "The question is: do we *want* to continue to use these fossil fuels at current—or increasing—rates until they are eventually exhausted? The answer, unequivocably, is no. The economic, social, and environmental costs of such an approach are becoming ever clearer and ever higher." Or, as the German Advisory Council on Global Change put it, "The 'fossil-nuclear metabolism' of the industrialized society has no future. The longer we cling to it, the higher the prices will be for future generations."[5]

In short, for all the power of the fossil fuel players, their deliberate construction of fossil fuels' net beneficence and inevitable use is beginning to crumble.

A Politics of Urgent Transition

To limit extraction, not just manage emissions, requires a particular kind of politics. Its thrust is accelerating the transition out of fossil fuels, confronting extremely powerful actors, and creating a norm of the good life, life without endless expansion and extraction.

The politics of this transition is ultimately moral, and so the ultimate strategy is delegitimization. This does not mean a vilification of the fossil fuel industry. The industry has a century and more of vilification, starting with charges against Rockefeller's Standard Oil (the "Octopus") and continuing through to today (Hofmeister entitled his book *Why We Hate the Oil Companies*). Nor does this mean simply a repudiation of the industry's anti-democratic, anti-environmental tactics. Rather, delegitimization means the reconceptualizing and revaluing of fossil fuels—or, to be precise, of humans' relationship with fossil fuels. It means a shift in understanding of fossil fuels from constructive substances to destructive substances, from necessity to indulgence or even addiction, from a "good" to a "bad," from lifeblood (of modern society) to poison (of a potentially sustainable society).[6]

In other words, fossil fuels will make a moral transition in parallel to the material transition. Much as slavery went from universal institution to universal abomination and as tobacco went from medicinal and cool to lethal and disgusting, the delegitimization of fossil fuels will flip the valence of these otherwise wondrous, free-for-the-taking complex hydrocarbons. And rather than pin blame on "big bad oil (and coal) companies" or, even worse, on "all of us" because everyone uses fossil fuels, delegitimization simply recognizes

that a substance once deemed net beneficial can become net detrimental. As in abolition and the delegitimization of smoking, what it takes is some compelling examples (begin with climate disruption and smog, add acid rain and oil slicks, include carbon monoxide and scores of other air pollutants), incisive critics, effective communication, and—for the moral entrepreneurs—a whole lot of persistence and willingness to be vilified.[7]

Delegitimization of fossil fuels would start with the simple observation that there are some things humans cannot handle. And for these things, humans can decide not to use them, just as they have with respect to ozone-depleting substances, lead in paint and gasoline, drift nets, land mines, rhino horns, and someday, perhaps, nuclear power plants and nuclear weapons.

Fortunately, some bold and clever people, North and South, are already saying no to fossil fuels and other mined materials. Their experiments, indeed their courage, suggest that such delegitimization has begun. This is particularly true among otherwise marginalized peoples. Their politics is not parochial protectionism, not localism. It is simultaneously protecting livelihood and the planet. Every new act of local resistance contributes to a new normative belief, one that says that the game is illegitimate, that it benefits a powerful few and their clients while fobbing the costs off on others in space and time. While such local acts of resistance are quickly dismissed as NIMBY (Not in My Back Yard) by defenders of the fossil fuel order, from the perspective of global threat and globalization from below, they are part of a larger project of delegitimization.

And so, what the climate scientists and others started yet cannot finish with their top-down, expert-led, apolitical, managerialist schemes and technological fixes is being augmented and accelerated by moral commitments in small pockets all over the world. But clearly fossil-fuel-dependent societies cannot stop cold. They can, however, start stopping now. One ethical justification for continued fossil-fuel-consumption is to facilitate a future without fossil fuels. Others are self-preservation and self-defense. What is more, because the transition away from current high-energy patterns will require considerable energy, those societies and communities deliberately living on little energy will have an advantage. Local action matters most in part because a top-down, centralized phaseout of fossil fuels by those with the most to lose is highly unlikely.[8]

Finally, delegitimizing a substance (or a process like exploring and drilling), as opposed to condemning an actor or all of humanity, puts the focus on the offending substance or, more specifically, on its use. Fossil fuels are perfectly "natural"; traditional uses of petroleum (rock oil) for pitch, lighting, and medicinal purposes were, for all we can tell, only harmful locally if at all. In a strategy of delegitimization, the burden shifts from the contest of interest groups (environmentalists versus industrialists, for example) to a

contest over the politics of the good life. Industrialists have enacted one vision of the good life. Its efficacy in the twentieth century can be debated, but the politics of delegitimization are about now and the future, including the distant future. It is an affirmative politics, about creating a different vision of the good life given the biophysical trends under way.

Early Efforts to Keep Fossil Fuels in the Ground

On the face of it, keep them in the ground, for all its environmental and ethical justifications, is just an idea. The world is happily (some might say madly) pumping oil, devouring coal, and capturing natural gas—all at record levels. Everyone wants in the game for reasons of profit and power (or both), everyone from private energy companies to petrostates to investors. The juggernaut is rolling across the landscape; it cannot be stopped.

Except in some places, including some of the unlikeliest of places—major oil-producing countries, for instance—where key actors have begun stopping this monstrous vehicle. None of these exceptions are successful in the sense of a complete shutdown of fossil fuel extraction. None are large-scale. But all are significant in that these actors have had the temerity to challenge an established order that is local, national, and international as well as hugely powerful. What is more, these efforts are occurring largely peacefully and through democratic means. And perhaps most significant, they are doing so at a time when the world as a whole sees no crisis, no existential threat, just the odd pollutant to clean up, emissions to be managed, and efficiencies to be realized.

In the global South, for example, coalitions of indigenous peoples, nongovernmental organizations, and government agencies in Ecuador and Bolivia have rewritten their constitutions to enshrine the right of nature and define a new model of sustainable development, one that excludes fossil fuels. In Ecuador, it is called *sumak kawsay* in Quichua, *buen vivir* in Spanish, and the *good life* in English. The leaders there recognize that petroleum production will eventually decline, that there have been long-term costs to Ecuador, and that costs to the planet are becoming increasingly dangerous.[9]

As a first step, the Yasuní-ITT Initiative proposes keeping 20 percent of Ecuador's known oil reserves in the ground. It calls for coresponsibility with the rest of the world in avoiding emissions that the nearly 900 million barrels of oil in the ITT block could produce. The international community would pay for avoided carbon emissions to protect one of the most biodiverse spots on Earth and to limit in a small way global emissions. It would also protect the rights of at least two indigenous groups that live there in voluntary isolation. The $350 million per year that Ecuador seeks for 13 years (half of what they estimate the reserves would earn from oil extraction) would be placed in a U.N. Development Programme Trust Fund with a board of directors

that includes Ecuadorans as well as members of the global community. If successful, it would be one of the largest global environmental trust funds of its kind. And it would be created not by burning fossil fuels, but by keeping them in the ground.[10]

Costa Rica, a small Caribbean country with known oil reserves offshore, enacted a moratorium in 2002 on oil extraction, citing ecological and social damage. In his 2002 inaugural address, President Abel Pacheco declared "Costa Rica will become an environmental leader and not an oil or mining enclave." He went on to say, "Costa Rica's real oil and real gold are its waters and the oxygen produced by its forests." Despite a brief encounter with the oil industry in the 1980s and recent considerations of natural gas exploration, Costa Rica has maintained its stance against this industry in favor of ecotourism and alternative energy sources and has achieved high human development indicators.[11]

In the global North, however, fossil fuels once left in the ground as too expensive to retrieve are being revisited. In the United States, federally funded research in the 1980s led to major innovations in imaging and mapping gas-rich shale deep beneath the surface. Blasting the shale with high pressure fracking fluids and drilling horizontally in multiple directions with powerful new diamond-studded drill bits add up to what became known as "slick-water, high-volume horizontal hydraulic fracturing," commonly referred to as *hydrofracking* or just *fracking*.[12]

Tim Lewis

The machinery of fracking deployed at a site in Texas.

As a result, massive amounts of shale gas can be reached profitably. These shale gas "plays," as the industry refers to them, are spreading rapidly in the traditional coal and oil states: Pennsylvania, Texas, and West Virginia. But when landsmen began knocking on doors in rural New York State enticing homeowners to lease their property for access to the vast Marcellus Shale beneath them, a keep-it-in-the-ground movement came to life. Landowners, environmental activists, artists, and indigenous peoples organized and protested, putting pressure on state and local officials. In 2010, New York Governor David Patterson ordered a moratorium on hydrofracking permits until the state completed an environmental and regulatory review. As of this writing, the latest state proposals would ban

hydrofracking in the watersheds from which New York City and Syracuse get their unfiltered municipal supplies; surface drilling would be prohibited on state-owned land, including parks, and on forest areas and wildlife management areas.[13]

In the process, the state Department of Environmental Conservation received more than 13,000 public comments overwhelmingly in opposition to drilling in the remaining areas. Not leaving the decision up to the state, many local municipalities have approved or are considering zoning ordinances and outright bans. These are likely to be challenged in state courts. Concerns focus mostly on the threat to water supplies and aquifers from a process that involves the injection of large volumes of water, industrial fracking chemicals, and sand under high pressure. Water and contaminants are involved in every step of the process: transporting water to the drill site, mixing the chemicals, blasting the shale, recovering the fluids that come back with the gas, and, finally, transporting, treating, and disposing of the wastewater.[14]

Among the most vocal and powerful voices in the hydrofracking uprising have been those of the indigenous peoples of New York State. Representatives of the traditional leadership of the Haudenosaunee (the Iroquois) have pointed out that large-scale industrial drilling would likely disturb burial grounds and other sites of historical and spiritual importance. They have called on the U.S. government to uphold their water and land rights as guaranteed in multiple treaties between the United States and native nations. They remind the state and its citizens that while the gas industry's concern only spans the period of time when the well produces gas, it is everyone's responsibility to protect the land and the water for future generations.[15]

The outcome of the anti-fracking movement in New York State remains inconclusive. Fracking is on hold for now, but the pressures to exploit the resource are great. And conventional environmental arguments do not seem to be enough. What may turn out to be the most significant outcome is a public increasingly open to the possibility of keeping fossil fuels in the ground, an idea largely attributable to the new and powerful influence of Haudenosaunee leaders and the introduction of indigenous perspectives and values into a debate that would otherwise be narrowly technical and economic.

Farther south, long-standing resistance to destructive coal mining practices in Appalachia appear to be taking a new turn, shifting in places from improving practices and cleaning up waste to ending coal extraction entirely. Around the world there are citizen-led actions to keep destructive substances in the ground and stop destructive practices, from uranium in Australia and gold in El Salvador to gold and diamonds in Guyana and oil in the Norwegian Arctic. These examples, though small in the larger scheme of global energy production and consumption, signal a rippling of resistance

around the globe against extractivist policies and, simultaneously, support for a good life without fossil fuels.[16]

Envisioning a Post–Fossil Fuel Era

Imagining deliberately keeping fossil fuels in the ground, much less the end of the fossil fuel era, is difficult. No matter how much environmental science is absorbed, how much geologic and ecological perspective is attained, how much ethical commitment is mustered, it is hard to escape industrial progressivism. It just seems like all this modernity will continue, albeit with adjustments—an efficiency here, some greening up there.

In fact, this pervasive impression—that the fossil fuel era has been around for a long, long time and will be for a long, long time to come, indeed that it must be—this impression has been deliberately constructed by the industry and its industrial and governmental enablers. Physical reality, however, speaks otherwise. Unfortunately, for fossil fuel proponents anyway, there is just too much knowledge piled up to believe in the indefinite perpetuation of the fossil fuel era, and not just scientific knowledge but political and strategic knowledge.

So a primary task for those who believe that the fossil fuel era will not continue, and yet will not end soon enough to avoid catastrophic outcomes, is to imagine that end. To facilitate such imagining, arguably a necessary precursor to designing policies and behavior change strategies, we offer two observations as an envisioning exercise.[17]

First, the fossil-fuel era, which began in the 1890s, when fossil fuels surpassed wood as the dominant energy source, is only about six generations old. Many of us alive now have personally known people who lived before the fossil-fuel era. It was not that long ago. The fossil fuel era is not that permanent, nor is its continuation that inevitable. Given that the initial stage of an energy source's use is one where benefits are highlighted and costs unknown or shaded (displaced in time and space), we can expect that fossil fuels have the same quality, only on a far grander scale than anything before. Coal's depredations—from miners' bodies to asthmatics' lungs, from decimated mountains in Appalachia to dug-out deserts in Mongolia —are well known. Coal's early exit is virtually a no-brainer. No wonder the industry's anti-climate-change activism has been so vehement. Oil, arguably the most consequential energy source of all time, is widely deemed essential (and thus the rush for alternative liquid fuels), but it too will eventually fade out.[18]

The costs of fossil fuels, from traffic casualties to climate disruption, will eventually catch up. The fossil-fuel era will come to an end well before conventional analysis and decisionmaking would indicate. And just as global fossil-fuel production will decline as all wells and oil fields do, the industry

will decline, too. Just because no one in the industry or anyone dependent on it (virtually everyone) wants to talk about this does not make it otherwise. Fossil fuel production and the fossil fuel industries will most assuredly decline.

Second, one place to start the imagining is, ironically enough, the fossil fuel industry itself. Preliminary evidence suggests that serious people in the oil, gas, and coal industries along with the automobile and petrochemical industries know this game cannot go on. "Energy executives know that the existing supply capacity from traditional sources is about tapped out," writes former Shell president John Hofmeister. They know the easy stuff is effectively gone. Now, they are learning, it is also changing the climate, melting the very tundra their trucks depend on, blowing apart rigs they thought were secure. What they say publicly is different, of course. Their jobs, their way of life, their personal and professional identity, their future is on the line. They seem to pray that a miracle technology will come along to keep the game going a little while longer. This difficulty is perfectly understandable. And yet people in equally entrenched positions (witness slavery and smoking) have made huge shifts in position.[19]

In short, a deliberate policy, state-led or not, of keeping fossil fuels in the ground is at once preposterous and perfectly sensible. Stranger things have happened. How it would happen, at what rate, with what local effects, is still anyone's guess. That fossil fuels will be in the ground and stay there when the fossil fuel era ends is beyond doubt. The only question is whether enough will stay to stabilize climate, reverse degrading trends, and avert social calamity. Bringing about an urgent transition begins with a certain kind of politics, one of delegitimizing fossil fuels and humans' deeply problematic relationship to them. This is a politics that recognizes that once fossil fuels are out of the ground, their by-products will permeate our bodies, the oceans, and the atmosphere and cause catastrophic loss. Those politics and the policies and economies that follow constitute a necessary first step in choosing to end the fossil-fuel era.

3. Laurence Chandy and Geoffrey Gertz, "With Little Notice, Globalization Reduced Poverty" (blog), *Yale Global Online*, 5 July 2011; Paul Harrison and Fred Pearce, *AAAS Atlas of Population and the Environment* (Berkeley: University of California Press, for American Association for the Advancement of Science, 2011), pp. 43–46; WWF et al., *Living Planet Report 2012* (Gland, Switzerland: WWF, 2012), pp. 8–9; Millennium Ecosystem Assessment, *Living Beyond Our Means: Natural Assets and Human Well-being*, Statement from the Board (Washington, DC: Island Press, 2005), p. 3.

4. J. Hall, V. Brajer, and F. Lurmann, *The Benefits of Meeting Federal Clean Air Standards in the South Coast and San Joaquin Valley Air Basins* (Fullerton: California State University–Fullerton, Institute for Economic and Environmental Studies, 2008).

5. California Department of Toxic Substances Control, "Emerging Chemicals of Concern," at www.dtsc.ca.gov/assessingrisk/emergingcontaminants.cfm.

6. B. E. Erickson, "Bisphenol A under Scrutiny," *Chemical and Engineering News*, 2 June 2008, pp. 36–39; Public Works and Government Services Canada, *Statutory Instruments 2010, Canada Gazette Part II*, 13 October 2010, 144(21):1806–18.

7. Principles for Responsible Investment and U.N. Environment Programme Finance Initiative, *Universal Ownership: Why Environmental Externalities Matter to Institutional Investors* (London and Geneva: 2010), pp. 2–7; Theo Ferguson, "A Fossil Fuel Diet—Taking Action to Get from Here to There," *Green Money Journal*, fall 2011.

8. Securities and Exchange Commission (SEC), "Commission Statement about Management's Discussion and Analysis of Financial Condition and Results of Operations," Washington, DC, 22 January 2002.

9. E. Lynn Grayson and Patricia L. Boye-Williams, "SEC Disclosure Obligations: Increasing Scrutiny on Environmental Liabilities and Climate Change Impacts," in Lawrence P. Schnapf, ed., *Environmental Issues in Business Transactions* (Chicago: American Bar Association, 2011), pp. 447–69.

10. Global Reporting Initiative, *A New Phase: The Growth of Sustainability Reporting: GRI's Year in Review 2010/11* (2011), p. 6.

11. BP, *BP Sustainability Review 2009* (London: 2009), p. 5; BP, *BP Sustainability Review 2010* (London: 2010).

12. International Integrated Reporting Council (IIRC), at www.theiirc.org.

13. IIRC, "Draft Framework Outline," 11 July 2012, pp. 5, 7.

14. IIRC, *Capturing the Experiences of Global Businesses and Investors: The Pilot Programme 2012 Yearbook* (2012), p. 7.

15. Sustainability Accounting Standards Board, at www.sasb.org.

16. Association of Certified Chartered Accountants, Flora and Fauna International, and KPMG, *Is Natural Capital a Material Issue?* (London: 2012), p. 8.

17. "Benefits of Signing the NCD" and "The Declaration," at www.naturalcapitaldeclaration.org

18. IIRC, "Pilot Programme," at www.theiirc.org/companies-and-investors, viewed 12 December 2012.

Chapter 14. Keep Them in the Ground: Ending the Fossil Fuel Era

1. For an illustration of an idealistic energy transition, see "Shift: To A Smarter Energy Future" (documentary), Arcos Films, 2012; for a realistic, historically and empirically grounded view of energy transition, see Vaclav Smil, *Energy Transitions: History, Requirements, Prospects* (Santa Barbara, CA: Praeger, 2010), Chapter 2.

2. Percentage of world energy from Vaclav Smil, "Global Energy: The Latest Infatuations," *American Scientist*, vol. 99 (2011), pp. 212–19; national oil company portion from "Introduction and Overview," in David G. Victor, David R. Hultz, and Mark C. Thurber, eds., *Oil and Governance: State-Owned Enterprises and the World Energy Supply* (Cambridge, U.K.: Cambridge University Press, 2012), pp. 3–31; industry capitalization from Michael L. Ross, *The Oil Curse: How Petroleum Wealth Shapes the Development of Nations* (Princeton, NJ: Princeton University Press, 2012), p. 3; ExxonMobil profits from Steve Coll, *Private Empire: ExxonMobil and American Power* (New York: Penguin Press, 2012) p. 8; 2010 statistics from *Global Trends* at http://www.globaltrends.com/knowledge-center/features/shapers-and-influencers/66-corporate-clout-the-influence-of-the-worlds-largest-100-economic-

entities. Box 14–1 from the following: Smil, op. cit. this note; Smil, op. cit. note 1, p. 117; James Clark, *BP Energy Outlook 2030*, at www.bp.com; International Energy Agency, "How Will Global Energy Markets Evolve to 2035?" *World Energy Outlook 2011 Factsheet*, at www.worldenergyoutlook.org; Roni A. Neff et al., "Peak Oil, Food Systems, and Public Health," *American Journal of Public Health*, September 2011, p. 1,589; Carbon Tracker Initiative, *Unburnable Carbon: Are the World's Financial Markets Carrying a Carbon Bubble?* March 2012, at www.carbontracker.org; Paul R. Epstein and Jesse Selber, eds., *Oil: A Life Cycle Analysis of Its Health and Environmental Impacts* (Boston: Center for Health and the Global Environment, Harvard Medical School, 2002), p. 4.

3. Richard Dobbs et al., *Resource Revolution: Meeting the World's Energy, Materials, Food, and Water Needs* (McKinsey Global Institute and McKinsey Sustainability & Resource Productivity Practice, 2011), p. 15; German Advisory Council on Global Change, *World in Transition: A Social Contract for Sustainability: Summary for Policy-Makers* (Berlin: 2011), p. 4; petroleum royalties from *U.S. Department of the Interior News*, 20 November 2008, cited in Coll, op. cit. note 2, p. 606; Saudi percentages from Ross, op. cit. note 2, p. 45.

4. Resource curse statements from Ross, op. cit. note 2, pp. 189, 236, 253.

5. Woolsley statement from Annie Maccoby Berglof, "At Home: Jim Woosley. The Former Head of the CIA Wants to Wean the US Off Oil," *Financial Times*, 6 July 2012; John Hofmeister, *Why We Hate the Oil Companies: Straight Talk From an Energy Insider* (New York: Palgrave Macmillan, 2010), p. 48; German Advisory Council on Global Change, op. cit. note 3, p. 25.

6. Hofmeister, op. cit. note 5.

7. On moral entrepreneurs, see Ethan A. Nadelmann, "Global Prohibition Regimes: The Evolution of Norms in International Society," *International Organization*, autumn 1990, pp. 479–526.

8. Paul Hawken, *Blessed Unrest: How the Largest Movement in the World Came into Being, and Why No One Saw It Coming* (New York: Viking, 2007); Rob Nixon, *Slow Violence and the Environmentalism of the Poor* (Cambridge, MA: Harvard University Press, 2011); Robert Goodland, "Responsible Mining: The Key to Profitable Resource Development," *Sustainability*, vol. 4, no. 9 (2012), pp. 2,099–126.

9. Pamela L. Martin, *Oil in the Soil: The Politics of Paying to Preserve the Amazon* (Boulder, CO: Rowman and Littlefield Publishers, 2011).

10. Ibid.

11. "Ecological Debt and Oil Moratorium in Costa Rica," *Oilwatch International*, August 2005; "Costa Rica," in U.N. Development Programme, *Human Development Indicators*, at hdrstats.undp.org/en/countries/profiles/CRI.html; Adam Williams, "While Natural Gas Remains an Option, Chinchilla Says No to Oil Drilling in Costa Rica," *Tico Times*, 17 June 2011.

12. Alex Trembath et al., *Where the Shale Gas Revolution Came From* (Oakland, CA: Breakthrough Institute, 2012).

13. Peter Applebome, "On Drilling, Patterson Pleases Both Sides," *New York Times*, 13 December 2010.

14. Trembath et al., op. cit. note 12; New York State Department of Environmental Conservation, "Draft Supplemental Generic Environmental Impact Statement (DSGEIS) Relating to Drilling for Natural Gas in New York State Using Horizontal and Hydraulic Fracturing," at www.dec.ny.gov/energy/75370.html.

15. Dusty Horwitt, *Drilling Around the Law* (Washington, DC: Environmental Working Group, 2010); Onondaga Nation, "Traditional Native Leaders: Hydrofracking Must Be Banned," press release (Albany, NY: Onondaga Nation, 5 November 2009); Haudenosaunee Environmental Task Force, "Haudenosaunee Statement on Hydrofracking," Rooseveltown, NY, 2009; Onondaga Nation, "Onondaga Nation's Statement to NYSDEC on 'Hydro-fracking,'" press release (Syracuse, NY: 12 January 2012).

16. Appalachian coal from Laura Bozzi, Yale School of Forestry and Environmental Studies, dissertation in progress; uranium from James Goodman, "Leave It in the Ground! Eco-social Alliances for Sustainability," in Josée Johnston, Michael Gismondi, and James Goodman, eds., *Nature's Revenge: Reclaiming Sustainability in an Age of Corporate Globalization* (Peterborough, Canada: Broadview Press, 2006), pp. 155–82; gold in El Salvador from Robin Broad and John Cavanagh, "Like Water for Gold in El Salvador," *The Nation*, 1–8 August 2011; gold and diamonds from "Guyana Bans Gold, Diamond Mining In Rivers," *Jamaica-Gleaner*, 8 July 2012; oil from Berit

Kristoffersen and Stephen Young, "Geographies of Security and Statehood in Norway's 'Battle of the North,'" *Geoforum*, July 2010, pp. 577–84.

17. Donella Meadows, "Envisioning a Sustainable World," paper presented at the Third Biennial Meeting of the International Society for Ecological Economics, San Jose, Costa Rica, 24–28 October 1994, pp. 1–6.

18. Barbara Freese, *Coal: A Human History* (New York: Penguin, 2003), pp. 190–97.

19. Evidence of change in fossil fuel industries in part from informal interviews with high-level officials in the automobile and oil industries; see also George Mobus, "Industry Leaders Seem to be Showing More Openness to Energy Descent Issue" (blog), *The Oil Drum*, 4 May 2010; Hofmeister, op. cit. note 5, p. 168; evidence for end of cheap energy from Robert L. Hirsch, "The Inevitable Peaking of World Oil Production," *Atlantic Council Bulletin*, vol. XVI, no. 3, from Richard D. Kerr, "World Oil Crunch Looming?" *Science*, 21 November 2008, and from Robert Rapier, "German Military Study Warns of Potential Energy Crisis" (blog), *The Oil Drum*, 2 September 2010; Coll, op. cit. note 2; Adam Hochschild, *Bury the Chains: Prophets and Rebels in the Fight to Free an Empire's Slaves* (Boston: Houghton Mifflin, 2005); Allan M. Brandt, *The Cigarette Century: The Rise, Fall, and Deadly Persistence of the Product that Defined America* (New York: Basic Books, 2007).

Chapter 15. Beyond Fossil Fuels: Assessing Energy Alternatives

1. Early application of coal from E. A. Wrigley, *Energy and the English Industrial Revolution* (New York: Cambridge University Press, 2010), p. 45.

2. Author's estimate.

3. Annual growth at 3 percent from U.S. Energy Information Administration, *Annual Energy Review* (Washington, DC: 2011), Appendix E; current global power demand from International Energy Agency (IEA), *Key World Energy Statistics* (Paris: 2010), p. 6.

4. T. W. Murphy, Jr., "Can Economic Growth Last?" *Do the Math*, at physics.ucsd.edu/do-the-math/2011/07/can-economic-growth-last.

5. Hydroelectric power potential from Eurelectric, *Study on the Importance of Harnessing the Hydropower Resources of the World* (Brussels: April 1997).

6. Figure of 81 percent from IEA, op. cit. note 3, p. 6; automobile efficiency from R. A. Ristinen and J. J. Kraushaar, *Energy and the Environment*, 2nd ed. (New York: John Wiley and Sons, 2006), p. 71.

7. T. W. Murphy, Jr., "The Alternative Energy Matrix," *Do the Math*, at physics.ucsd.edu/do-the-math/2012/02/the-alternative-energy-matrix.

8. Photovoltaic panel production from G. Hering, "Year of the Tiger," *Photon International*, March 2011, p. 186; W. F. Pickard, "A Nation-Sized Battery," *Energy Policy*, June 2012, pp. 263–67; small number of locales from T. W. Murphy, Jr., "Pump Up the Storage," *Do the Math*, at physics.ucsd.edu/do-the-math/2011/11/pump-up-the-storage.

9. Considerable fraction of present needs from C. de Castro et al., "Global Wind Power Potential: Physical and Technological Limits," *Energy Policy*, October 2011, pp. 6,677–82.

10. Compelling possibility from E. S. Andreiadis, "Artificial Photosynthesis: From Molecular Catalysts for Light-driven Water Splitting to Photoelectrochemical Cells," *Photochemistry and Photobiology*, 8 August 2011, pp. 946–64; U.S. Department of Energy project from "Fuels from Sunlight Hub," at energy.gov/articles/fuels-sunlight-hub, 1 August 2010.

11. Judy Dempsey and Jack Ewing, "Germany, in Reversal, Will Close Nuclear Plants by 2022," *New York Times*, 30 May 2011; Risa Maeda and Aaron Sheldrick, "Japan Aims to Abandon Nuclear Power by 2030s," *Reuters*, 14 September 2012; Ayesha Rascoe, "U.S. Approves First New Nuclear Plant in a Generation," *Reuters*, 9 February 2012.

12. Fully 99.7 percent of natural uranium is U-238 while 0.7 percent is U-235; see Ristinen and Kraushaar, op. cit. note 6, p. 184.

13. Ristinen and Kraushaar, op. cit. note 6, pp. 145–50.

Advance Praise for
State of the World 2013: Is Sustainability Still Possible?

"*State of the World 2013* cuts through the rhetoric surrounding sustainability, providing a broad and realistic look at how close we are to achieving it and outlining practices and policies that can steer us in the right direction. . . . A must-read for those seeking authentic sustainability."

—Hunter Lovins, President, Natural Capital Solutions and Author of *Climate Capitalism*

"This is a book of hope for a world in profound crisis. It gives honest assessments of the enormous challenges we face and points us toward institutional and cultural changes that are proportional to our dire situation. *State of the World 2013* reaffirms that we are not helpless but that we have real choices—and that transformation is both possible and desirable."

—Reverend Peter S. Sawtell, Executive Director, Eco-Justice Ministries

"*State of the World 2013* cuts through 'sustainababble' with crisp coverage that puts the news of the year in context and provides an expert survey of today's and tomorrow's big issues. It's a perennial resource for everyone concerned about our common future."

—Karen Christensen, publisher of the 10-volume *Berkshire Encyclopedia of Sustainability*

"Every elected official in the world needs to read this book. Mass denial is no longer an option. An 'all hands on deck' approach to transforming our culture and economy is the only path to a safe, resilient future. This book is the blueprint for that safe path forward."

—Betsy Taylor, President, Breakthrough Strategies & Solutions and Founder, Center for a New American Dream

SCIENCE | ENVIRONMENT

2013

STATE OF THE WORLD

Is Sustainability Still Possible?

"State of the World 2013 assembles the wisdom and clarity of some of the earth's finest thinkers, visionaries, and activists into a dazzling array of topics that merge to offer a compellingly lucid and accessible vision of where we are—and what is the wisest and healthiest course for the future."

—**NINA SIMONS,** Cofounder, Bioneers

"This edition forges a new path for the *State of the World* series, and for environmental thinking in general. . . . A pivotal book that marks a defining moment for our species."

—**RICHARD HEINBERG,** Senior Fellow, Post Carbon Institute, and author of *The End of Growth*

"State of the World 2013 is a powerful collection of articles, and the vision behind it is impressive. Here is a book that gets beyond 'sustainababble' and asks the tough, essential questions. It should make readers more determined than ever to do their part in avoiding planet-wide disaster—and better informed about how to do that."

—**PETER SINGER,** Professor of Bioethics, Princeton University, and author of *Animal Liberation, One World,* and *The Life You Can Save*

Sustainability gets plenty of lip service, but the relentless worsening of key environmental trends reveals much of that attention to be "sustainababble." From climate instability and species extinctions to approaching scarcities of freshwater, minerals, and energy, worrisome limits to human economic activity look more pressing each year—all while our political institutions seem impotent to address the challenge.

THE WORLDWATCH INSTITUTE, in this edition of the celebrated *State of the World* series, takes an unflinching look at what the data say about the prospects for achieving true sustainability, what we should be doing now to make progress toward it, and how we might cope if we fail to do so.

ISLANDPRESS

Washington | Covelo | London
www.islandpress.org
All Island Press books are printed on recycled, acid-free paper.
Cover photos: *Binoculars Reflecting the Sky* ©iStockphoto.com/Jill Fromer
Rain clouds, vertical ©iStockphoto.com/Adrian Assalve

ISBN 13: 978-1-61091-449-9
ISBN 10: 1-61091-449-X
90000 >
9 781610 914499