CHAPTER 3

The Air We Breathe

The Human Costs of Coal Combustion

THE REASONS coal has become the fuel most used to generate electricity in the United States—not to mention countries like China, and India, where it's even more dominant—are not hard to identify. Unlike oil, which must be imported from distant and untrustworthy foreign suppliers, it is available right here and readily recoverable in gigantic quantities. What is more, it will be in adequate supply for centuries to come. Most important of all, considered in a narrow monetary sense, burning coal is the cheapest way of generating electricity. As oil and natural gas prices skyrocketed, starting in 2003, coal's advantage has widened. This is why it accounts for well over half the electricity produced in the United States.

Coal's disadvantages, on the other hand, are largely hidden. The entire process of extracting coal and then disposing of waste products, which are hugely voluminous, is confined to just a few geographically and sparsely populated regions of the country. Under normal circumstances, only a tiny fraction of the U.S. population ever sees the coal industry in action. As for the emissions from coal-fired electricity plants, even though they are thought to cause thousands of deaths annually in the United States and hundreds of thousands of added hospital admissions, their effects are entirely statistical: old Uncle John may have a chronic respiratory condition that was fatally aggravated by constant exposure to coal emissions, but nobody ever says, "Poor old John. He died from breathing coal smoke."

The greenhouse gases associated with coal combustion—mainly carbon dioxide—are completely invisible. Their effects came to be generally

recognized by the public only in recent decades, and even now, few people have any inkling just how drastic those effects are. The climate ramifications of coal combustion are the main theme of this book. But to think sensibly about all the advantages and disadvantages of coal, versus the alternative energy sources that will be considered in part 3, it's necessary first to have a complete view of coal's downside as well as its upside.

Anybody who has ever suffered a serious asthma attack, or watched almost helplessly as a child or aging parent struggled with one, knows the terror of not knowing for sure whether the next breath will be enough. Besides being enormously debilitating and requiring constant vigilance among chronic sufferers and those who care for them, asthma can and often does kill. When aggravated by particulates in the air, including aerosols formed from sulfur and nitrogen compounds, the condition is even more recurrent, debilitating, and frightening, and somewhat more deadly. The same is true of other medical conditions that can be compounded or even induced by exposure to severe pollution levels—upper and lower respiratory conditions of every kind, from minor colds to progressive bronchitis and fatal bouts of pneumonia, as well as cardiopulmonary conditions that can lead in the extreme case to cardiac arrest. On the hottest and most unpleasant summer days, when ozone alerts are declared throughout the eastern United States, the old and infirm are warned to stay inside and minimize activity. The ozone in the lower atmosphere that can stop their hearts is a by-product of power plant combustion and vehicle emissions. (This should not be confused with stratospheric ozone. Although chemically identical, it shields us from ultraviolet radiation and, until recently, was thinning dangerously as a result of reactions with chlorofluorocarbon gases used in refrigeration systems and aerosol spray cans.)

The kinds of noxious atmospheric conditions that can affect half the country at once fortunately are rare events. But in the most polluted parts of the country, where power plants are concentrated or traffic congestion is at its worst, dangerously high levels of pollution are not unusual, and the more astute physicians treating patients with conditions like asthma learn to watch out for them. Those places are not always where one might imagine.

Take Asheville, a pleasantly sleepy town in western North Carolina, on the edge of the scenic Smoky Mountains, best known to America

at large as the birthplace of the novelist Thomas Wolfe. If one were to map the country's largest coal-burning utilities—Ohio's American Electric Power and Cinergy, Atlanta's Southern Company, and North Carolina's own Duke Power among them—and draw lines connecting all their coal-fired plants, the lines would all intersect in Asheville's vicinity. Accordingly, it ranks as one of the country's most chronically polluted cities. Wolfe famously said, "You can't go home again." But if you happen to be a less advantaged citizen of Asheville, and if you have the bad luck to suffer from asthma and find yourself showing up often in the middle of the night at a local clinic for emergency nebulizer treatments, you may wish you could just leave home and live somewhere else, anywhere else.

Cincinnati, Ohio, though not far at all from Asheville as the crow flies or the coal particulate blows, corresponds better to the average person's preconception of what a really polluted city is like. In the southeastern part of the state, on the Ohio River, Cincinnati indeed is one of the more difficult places to live and breathe freely. Dr. Jonathan A. Bernstein, an associate professor of clinical medicine at the University of Cincinnati's College of Medicine, reports that on high-smog days, he regularly sees more asthma visits and more patients generally suffering from shortness of breath, wheezing, and coughing.[1] On the very smoggiest days, he tells his patients to try not to come in at all because being outside may be more dangerous than going without treatment. And those very smoggy days are not uncommon, as emissions from local power plants tend to get trapped down low in the Ohio Valley during temperature inversions, in which cold air holding pollutants is trapped near the surface by a warmer layer immediately above, so that the normal process of upward convective diffusion is stopped. Though smog may be associated in people's minds mainly with traffic, and in places like Los Angeles or Washington, D.C. is in fact caused mainly by cars and trucks, in Cincinnati coal-fired power is overwhelmingly the source, says Bernstein. The pollutants blow in not just from plants in Ohio itself but also from those in neighboring West Virginia and Kentucky.

As chair of the American Academy of Allergy, Asthma and Immunology's committee on air pollution and author of a report about pollution for allergists, Bernstein knows what he's talking about. Yet even for a person of his experience, there is rarely, if ever, a case where the physician can say that pollution is the whole cause or even the main

cause of a specific patient's condition. "If patients are allergic, there are interactions between particles and allergens, and it's very difficult to disentangle that, though you might consult the air quality index to get a sense of the situation," he explains. The morbidity and mortality connected with air pollution, like the diseases well known to be associated with tobacco use, are by nature statistical. Only by conducting large epidemiological studies, in which every variable that could be relevant is controlled to gauge the effect of the pollutant in question, can its impact be guessed.

One measure of coal's importance in human affairs is that the history of efforts to accurately estimate its baleful effects is virtually coterminous with the history of statistics itself. In 1662, the father of modern statistics, John Graunt, took it upon himself to closely examine London's health records as an exercise and demonstration of the nascent science.[2] The city had hundreds of thousands of inhabitants, and already had been fueled for centuries almost entirely by coal. As early as 1285, King Edward I had established a commission to evaluate air pollution, and twenty-two years later he tried to ban coal burning in the city altogether.[3] Centuries later, a London visitor or dweller observed that "by reason…of the Smoak," the "Air of the City, especially in the Winter time, is rendered very unwholesome: for in case there be no Wind, and especially in Frosty Weather, the City is covered with a thick Brovillard or Cloud, which the force of the Winter Son is not able to scatter… when yet to them who are but a Mile out of Town, the Air is sharp, clear and healthy."[4] So Graunt was not the first to suspect that the smoke could not be good for people and other living things, and sure enough, when he tallied up his numbers, he estimated that one fifth to one fourth of all the deaths in London each year were the result of lung-related diseases.

Two hundred years later, when the abolitionist sisters Catherine and Harriett Beecher Stowe published a book about home economics, they worried about how domestic happiness was affected by the three or four tons of coal they guessed it took to heat the average American family home for a winter.[5] Yet the string of causes and consequences connecting coal smoke with deadly or debilitating ailments like lung cancer, asthma, emphysema, and heart failure still seemed speculative and abstract. It took the terrible London smog of December 8, 1952, and four years before that, a more limited but just as dramatic health emergency

in Donora, Pennsylvania, to start driving home the lethal impact of air pollution. Both events were induced by temperature inversions. In London, particulate and organic compounds combined with particulate sulfur dioxide and nitrogen oxides from domestic and industrial coal combustion, to form a noxious brew. The number of deaths above the number that normally would have been expected in London during the week right after the inversion was estimated at 2,800.[6]

In the case of Donora, the trapped pollutants came almost entirely from the batteries of coke ovens that were the lifeblood of this company town, located just southwest of Pittsburgh. The immediate death toll on and right after October 26, 1948, the day Donora suddenly was smothered by almost unbreathable air, was eighteen.[7] The longer-term impact remains uncertain to this day, partly because Pennsylvania's head of public hygiene dismissed it as a "one-time atmospheric freak,"[8] partly because statisticians were still developing the refined techniques needed to distinguish deaths that occurred prematurely or need not have occurred at all from those that would have happened as a matter of course.

As late as the early 1970s, when a professor at Pittsburgh's Carnegie Mellon University made one of the first comprehensive attempts to estimate the exact health effects of coal combustion, he still found the science politics rough sledding. Although Lester Lave was (and is) one of the country's foremost experts on the U.S. electric power industry, and although he submitted his work to a top mathematician at Princeton University, John Tukey, for a close critical review of his statistical methods, he nonetheless ran into considerable hostility, both from industry and from other epidemiologists. Just the same, the pathbreaking article he coauthored with Eugene Seskin and published in *Science* in 1970 was perhaps the first to definitively prove a causal relationship between pollution and death and disease.[9]

Lave and Seskin first surveyed previous work on the subject, then presented results of their own "cross-sectional" survey comparing U.S. cities with varying levels of pollution. They found that a 50 percent cut in urban pollution would reduce mortality and morbidity from bronchitis by 25 to 50 percent, all respiratory disease by 25 percent, and the cost of all cancer care by 15 percent. They estimated that the combined savings in health-care costs associated with the 50 percent reduction in pollution would be about $2 billion in 1970 dollars. They noted, however, that this was a tremendous underestimate of real total

costs, because it didn't account for earnings lost as a result of death and disease, let alone the value individuals placed on their own lives.

The Lave-Seskin study came under attack on technical grounds because it didn't correct for personal habits like smoking and because of possible false correlations: critics pointed out, for example, that big cities tend to be more polluted than smaller ones, and that people allegedly tend to die at higher rates in the bigger cities because of a supposed "urban effect." Critics also complained that the study contained no "longitudinal" analysis—that is, evaluation of how mortality and morbidity changed over time with varying pollution levels. Lave and Seskin did include longitudinal analysis and controls for personal habits in a comprehensive book they published in 1977, *Air Pollution and Human Health*,[10] but, by Lave's account, they were getting tired of the whole controversy, and critics often didn't seem to notice that their complaints had now been addressed.

The work by Lave and Seskin established an ironclad link between pollution and health. Yet to this day, observes Devra Davis, an eminent but controversial epidemiologist who happened to have grown up in Donora, "there has never been a surgeon general's report on air pollution"[11]—something comparable, that is, to the 1964 report that established a connection between smoking and ill health, and that led to the long but ultimately quite successful campaign to discourage tobacco use.

Nevertheless, two studies conducted in the early 1990s pretty well did what a surgeon general's report might have accomplished, not only providing persuasive evidence of the links between pollution and morbidity and mortality, but also yielding precise estimates of their magnitude. One, conducted by researchers with Harvard University's School of Public Health, focused on six cities with varying levels of air pollution. The other, sponsored by the American Cancer Society, was national in scope.[12] These studies prompted the Environmental Protection Agency to promulgate an emissions reduction standard for fine particulate (defined as 2.5 parts per million), which, the EPA estimated, might save about a quarter of the 60,000 American lives lost each year as a result of exposure.

Particulate pollution comes from numerous sources, including industrial processes that rely on coal and diesel vehicles. But coal-fired power plants top the list. The Clean Air Task Force, a Boston-based nonprofit advocacy group, determined in an October 2000 report that

power plants outstripped all other polluters as the main emitters of sulfur dioxide, which is the biggest single source of fine particulate pollution in the United States, and were the major source of nitrogen oxides, the other main fine-particulate precursor. The task force claimed, on the basis of calculations done by independent consultants and closely based on the EPA's own models, that if power plants were required to reduce their emissions of sulfur dioxide and nitrogen oxides by 75 percent, the effect would be to save about 18,000 lives a year—roughly the same number lost annually in drunk-driving accidents. That conclusion implied that the total number of deaths attributable each year to the two pollutants is about 30,000.[13]

Starting in 1970, with the creation of the Environmental Protection Agency by President Richard M. Nixon and the drafting of the country's landmark Clean Air Act by Nixon administration officials, the United States has made a concerted effort to clean the air. It has made much more progress in this endeavor than most other advanced industrial countries, which have tended to emphasize energy conservation more than mitigation of air pollution. But when President George W. Bush took office in January 2001, the struggle to bring coal-burning electric power plants into stricter compliance with clean air regulations was at a critical juncture.

During the 1970s and 1980s, largely as the result of a "cap-and-trade" system set up to reduce the acid rain that was sterilizing the country's rivers and lakes, output of sulfur dioxide—the main precursor to acid rain—had been cut by more than a third (see "Cap-and-Trade Versus Pollution Tax," below). That dramatic reduction was achieved at much lower costs than industry and independent analysts had expected. By allowing utilities for which reductions were too costly to purchase emissions credits from those that found compliance easier, the system introduced a flexibility appreciated by all parties to the clean air debate. The U.S. Environmental Protection Agency estimated that sulfur dioxide output was 40 percent lower in 1990 than it would have been without the cap-and-trade system.[14] During the next five years, from 1990 to 1995, emissions from the 261 most polluting power plants in the country—those required to come into compliance with 1990 clean air amendments first—dropped by another 45 percent, from 9.7 to 5.3 million metric tons.[15] That was achieved mainly by switching to lower-sulfur coal: in 1990 it accounted for about two thirds of coal utility

CHANGES IN ANNUAL U.S. COAL PRODUCTION FROM 1990 TO 1995

North Appalachia high-sulfur	–29 million tons
Illinois high-sulfur	–40 million tons
Wyoming/Montana low-sulfur	+78 million tons
Colorado/Utah low-sulfur	+10 million tons
Central Appalachian low-sulfur	+15 million tons

Source: U.S. Energy Information Administration

generation; just five years later, it was well over three quarters, as western displaced eastern coal (see table).

Impressive progress also was made in bringing the two other pollutants from power plants under control. Emissions of particulate were cut in half during the 1970s, while nitrogen oxides stayed flat, with reductions compensating roughly for increases that otherwise would have occurred. But progress slowed in the late 1990s, as utilities took advantage of a loophole in clean air legislation. They were required to see to it that new plants and equipment complied with target emissions levels, but if utilities could make a plausible claim that they were making routine improvements in existing facilities, then they could avoid installing costly scrubbing devices. The whole effort to continue cutting sulfur and nitrogen emissions came to a standstill over the issue of "new source review." This is the bureaucratic name for the regulatory process in which utilities and regulators sparred over whether plant upgrades were routine and therefore exempt from clean air requirements, or major.

Meanwhile, mercury loomed as an additional pollutant crying out for regulation, and environmentalists and industry were locking horns over whether greenhouse gas emissions also should be called pollutants and regulated as such. The two main greenhouse gases, carbon dioxide and methane, certainly were not noxious in the normal sense—at the concentrations being put into the atmosphere, they were not damaging to anybody's health, or even, unlike acid rain, to ecosystems or physical structures. But their growing presence in the atmosphere was well known to be gradually warming the planet, at a rate that was truly alarming. From 1990 to 2002, U.S. output of greenhouse gases increased 13 percent; the power sector accounted for a disproportionate share, with its emissions rising at least 25 percent.[16] (Though more up-

to-date data is unavailable at this writing, the rate of increase in power plant emissions has certainly been even greater since 2002, as sharply rising oil and gas prices have prompted U.S. utilities to burn more coal than ever before.[17]) If greenhouse gas emissions continued to grow that fast, it will be tough by any reckoning for the United States to live up to the pledge made at an international conference held in Kyoto in 1997 to get its carbon dioxide emissions well below 1990 levels by 2010 (see "What Is the Kyoto Protocol?" below).

Cap-and-Trade Versus Pollution Tax

In a cap-and-trade system, a ceiling is set for the total amount of a pollutant that can be emitted in a country or region in a given period of time. The economy is divided by industry or sector, and companies or organizations known to be releasing the pollutant are issued permits allowing them emissions up to some proportion of the total ceiling. All participating organizations may trade the allowances freely, so that those finding it easier to stay below their maximum level can sell allowances to those finding it harder. The system reduces the aggregate cost of meeting emissions targets and introduces a flexibility that industry likes.

This works relatively well for pollutants that are quickly dispersed in the atmosphere over long distances, so that it does not make much difference locally where emissions originate. Cap-and-trade was first implemented in the United States to reduce the chemicals that turn into acid rain, and it worked nicely. The system works less satisfactorily for heavy chemicals like mercury that tend to be deposited near their source: if your own food is contaminated with mercury from nearby sources, it obviously will not help you out if the emitter buys a permit from some other emitter to release even more into the environment. Cap-and-trade systems are very effective in controlling the main greenhouse gas, carbon dioxide, which mixes rapidly in the atmosphere, so that everybody is helped by emissions reductions made by anybody anywhere. The European Union has adopted a cap-and-trade system to meet the targets its member states have accepted under the Kyoto Protocol.

Arguably, however, a carbon tax is an even more efficient way of reducing carbon dioxide emissions. In keeping with free market principles, such a tax establishes a completely level playing field among all economic sectors and penalizes those organizations in exact proportion to the carbon they emit, without much need of central planning and sectoral partition. Because of coal's greater carbon output per unit of energy, compared with oil, such a tax affects the coal industry about twice as sharply as the automotive sector.

The Kyoto Protocol was adopted as a first step toward implementing the International Framework on Climate Change, a treaty formulated at Rio de Janeiro in 1992 that the senior George Bush had signed on behalf of the United States. But the protocol was closely associated with the controversial views and persona of Vice President Al Gore, and in signing the country on to it, President Bill Clinton plainly got too far ahead of public opinion. The Senate made clear in 1998 that it had no intention of ratifying the agreement, and in the 2000 presidential campaign, George W. Bush explicitly repudiated it.

The grounds for opposition to the protocol are easily identified. Bringing the United States into compliance with Kyoto would put an even bigger burden on the power sector than is evident at first glance. According to a 2001 governmental report prepared as part of the Kyoto negotiation process, coal-fired plants operated by U.S. utilities were responsible for 29 percent of carbon dioxide emissions (compared to the transportation sector's 26 percent). And that didn't include the growing production of electricity by generators other than utilities. Factoring them in, the report said, coal-fired power production accounted for close to 40 percent of U.S. greenhouse gas emissions.[18]

Small wonder, then, that in the 2000 election campaign, Vice President Al Gore—despite having played a big role in putting global warming on the political agenda and in midwifing the Kyoto Protocol as well—scarcely mentioned the subject. After all, he represented the high-sulfur coal state of Tennessee (which he managed to lose anyway), and it was taken for granted that other coal states like Ohio and Illinois would be decisive in the election outcome. In 2004, challenger John Kerry, despite a strong record on environmental issues, produced an exact repeat of Gore's performance. Again, it was taken for granted that coal-burning Ohio would be decisive, as indeed it was. Bush, for his part, did not conceal his disdain for Kyoto, which he said would disadvantage the United States in global trade; after winning the presidency in 2000, he lost no time rejecting it. He indicated in the run-up to the election that as president he would treat carbon dioxide as a pollutant to be regulated along with sulfur dioxide, nitrogen oxides, and ozone—but after taking office he repudiated that commitment too.

The Bush administration, in fact, watered down every kind of clean air measure during its first term. Notably, it drastically weakened plans to sharply curtail mercury emissions, and after a lengthy bureaucratic battle that ended up costing Bush's first EPA administrator her job, the

What Is the Kyoto Protocol?

The basic principles of the Kyoto Protocol were adopted at a conference in November 1997, but it took three more years of international negotiations to hammer out the agreement's complex details. The nations of the world were divided into so-called Annex 1 countries, which were required to meet certain greenhouse gas emissions targets by 2008–12, relative to a 1990 baseline, and developing countries, which are not subject to any emissions requirements in that period.

Confusingly, descriptions of the protocol often give different numbers for the total emissions reductions that industrial nations are required to make by 2010. This is probably because the targets differ for each country, and in some cases—recognizing many special circumstances—increases in emissions actually are allowed. Norway, Iceland, and Australia are permitted to increase emissions by as much as 10 percent, for example, and no cuts are required of Russia, New Zealand, or the Ukraine. The United States, had it ratified the agreement, would have been required to reduce its emissions by 7 percent. The European Union agreed to reduce its combined emissions by 8 percent.

The protocol covers six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. The degree to which each of these gases absorbs infrared radiation (their "global warming potential") varies extremely widely, offering opportunities to achieve targets by tailoring reduction strategies to particular gases. Methane has a greenhouse impact that is 23 times that of carbon dioxide, per molecule, and the impact of the hydrofluorocarbons is as much as 12,000 times that of carbon dioxide.

The protocol and its implementation agreements enable industrial countries to meet their targets partly by taking measures that absorb greenhouse gases, for example by planting new forests. The protocol recommends emissions trading among countries, an approach developed and favored by the United States, to meet global targets. Industrial countries also get credit for projects they foster in developing countries to reduce gases. The developing countries are required to start inventorying their greenhouse gas emissions, but they were exempted from the protocol's first-phase targets in recognition of the fact that rapidly growing societies cannot realistically promise to make cuts or even predict what targets are achievable.

Critics in the United States have complained that developing countries are getting a free ride. However, by not participating in the Kyoto system, the United States is benefiting free of charge from greenhouse gas emissions cuts made—often at considerable inconvenience—by the countries that have accepted it.

government announced its intention to ditch the new-source review process for sulfur dioxide reduction. First the administration tried to get the Department of Justice to drop enforcement suits against seven top midwestern and southern utilities; when Justice refused to do so, the EPA simply walked away from settlements that the utilities were about to accept. In August 2003, the Bush administration raised the threshold at which new source rules would kick in so much that the remaining senior air pollution enforcement officials from the Clinton administration took early retirement in disgust. A *New York Times Magazine* writer concluded, "The administration's real problem with the new-source review program wasn't that it didn't work. The problem was that it was about to work too well."[19]

Enforcement of regulations for mercury abatement also was weakened, according to a *Wall Street Journal* report, following a November 2003 meeting in which representatives of coal-burning utilities talked administration officials into relaxing the rules. A Clinton administration proposal would have required mercury emissions to be cut by 90 percent by 2007–8; the Bush plan called for 70 percent cuts by 2018.[20] About a third of the mercury that gets into the air each year comes from coal-fired power plants, which emit about 50 tons annually, making them the biggest single source.[21] Another third is from municipal and medical wastes, but those sources are being sharply curtailed. Regulation of mercury emissions from coal plants, on the other hand, remains hotly contested, to put it mildly.

Given the endless haggling that the new-source review process had engendered, perhaps a good argument was to be made for a different approach. Utilities in the most highly polluting states of the Midwest and Southeast had been the targets of endless litigation brought by the northeastern states most affected by sulfur dioxide, nitrogen oxides, and ozone blowing in from across their borders, without much tangible result. Bush proposed to replace the new-source process with a cap-and-trade system like the one that had proved successful in cutting acid rain. This seemed a good idea, except that the target dates set for compliance in his proposed "Clear Skies" program were set far into the next decade, much later than the targets originally established in the Clean Air Act and amendments that had set the new-source process in motion. Bush proposed no provision for tightening caps over time.

The debate over clean air regulation took a surprising turn in March 2005, when a Republican-controlled Congress narrowly rejected Bush's Clear Skies program. Almost immediately, the EPA issued a new plan for sulfur and nitrogen abatement, the Clean Air Interstate Rule, which represented a compromise between the original Clinton program and Clear Skies. Sulfur dioxide would be cut 70 percent from 2003 levels by 2015 and nitrogen oxides 60 percent, at a total estimated cost of at least $36 billion. The EPA predicted the program would ultimately result in 17,000 fewer premature deaths annually from air pollution, and 1.7 million fewer days lost to pollution-related illnesses. The new interstate rule was widely hailed as a step in the right direction. But a similar compromise plan for mercury abatement, issued days later, met with much sharper criticism from environmentalists and public health specialists. It too established a cap-and-trade system, which is a suitable method for reducing pollutants like sulfur dioxide or carbon dioxide that mix well in the atmosphere and are widely and evenly dispersed, but arguably not for reducing a heavy element like mercury that tends to stay concentrated in "hot spots." A deal made to trade mercury abatement in one area for continued pollution in another in effect leaves all the pollution in that one area.

Generally, while public health has taken a back seat in the Bush years, the administration has never dared say it is against cleaning the air on principle; its *modus operandi* has been to proceed in stealth mode, claiming that it is stretching deadlines to make compliance more realistic and to make the whole process more efficient. Reducing greenhouse gas emissions, however, is another matter. The president has said repeatedly that this is simply something the United States cannot afford to do.

The inventory of adverse coal impacts does not stop, of course, with the air pollutants and greenhouse gases. Mine safety and environmental issues associated with coal extraction also are major issues. Though mining fatalities are no longer a great scourge, as when more than a million Americans dug deep into the ground, the shift to strip mining and mountain lopping has brought new horrors: vast stretches of wondrous landscapes in Montana and Wyoming turned into desolate moonscapes on earth; beloved local scenery changed beyond recognition in West Virginia, Kentucky, and Tennessee, where hilltops are

Strip-mining operations on Kayford mountain, a half hour east of Charleston, West Virginia. Seams of coal can be seen in the exposed stone face, with a coal company truck barely visible (*top, right*). Across the valley, below the cemetery where generations of coal miners are buried (*middle, left*), lies a flat plateau, ringed with some trees and covered with grass (*bottom, right*), which used to be a mountain looming over the cemetery. The man in the middle photo is Julian Martin, a retired teacher and mining activist. *Source:* William Sweet

removed, crushed, and filtered, with the waste sludge dammed up in valleys, creating a whole new risk to public safety (see photographs).

Altogether, there are about 700 coal slurry dams or "impoundments" in the United States, about 200 of which are built over abandoned mines. On February 26, 1972, one such dam gave way in Logan County, West Virginia. Some 132 million gallons of sludge suddenly flooded the Buffalo Creek Valley floor, destroying 17 communities, killing 125 people, and leaving 4,000 homeless. In terms of volume, though thankfully there was no loss of life, the biggest such disaster occurred on October 11, 2000, in Inez County, Kentucky. Yet considerable evidence suggests that upon taking office several months later, the Bush administration's approach to the problem of the impoundments was to demote engineers in the Mine Safety and Health Administration who were best qualified to address it, to stack the agency's leadership with former mining executives, and to generally obstruct investigations into the Inez County disaster to protect responsible parties from civil and criminal liability.[22]

The administration has taken an essentially similar approach to the problem of mountaintop lopping. In May 2002, Judge Charles H. Haden II of the Southern District of West Virginia declared in a ruling that the administration's revisions to rules governing the practice represented an obvious perversion of the Clean Water Act. "The rule change was designed simply for the benefit of the mining industry and its employees," he said.[23] Yet in January 2004, the administration proposed further relaxation of the rules: lifting a Reagan administration prohibition on simply dumping mountain detritus into stream beds. The Interior Department's proposed new rule would allow the practice, provided water quality was protected "to the extent practicable."

As a matter of course, coal combustion generates millions of tons of waste—fly ash, bottom ash, and boiler slag—that must be disposed of each year. Ironically, when emissions are scrubbed for sulfur by means of flue-gas desulfurization (FGD) or electrostatic precipitation, the result is millions of tons of extra solid waste to be got rid of, and increased generating expenses. (FGD adds as much as 8 percent to electricity prices.[24]) Thus, scrubbing coal emissions trades a public health hazard for an admittedly lesser environmental blight, at significant monetary cost.

Although all that is serious enough, coal's most worrisome environmental effect is on the global atmosphere. Even though coal-fired

power accounts for only about a quarter of U.S. energy consumption while oil—almost all of it used to fuel automotive vehicles—accounts for 40 percent, their contribution to total greenhouse gas emissions is roughly the same. This is because of oil's greater chemical efficiency in terms of carbon emitted per unit of energy produced, and the relatively low average generating efficiency of the nation's aging power plants.

The correspondences between the oil-fired transportation and coal-fired power sectors are slightly uncanny, a bit like the similarity in size of the Sun and Moon as seen from Earth—that is to say, essentially coincidental, but helpful as memory aids and analytical devices. As noted, estimated yearly deaths from power plant emissions are at least as great as total yearly deaths from drunk-driving accidents, and possibly as great as total traffic fatalities. Each sector, though quite different in terms of how energy is converted and used, contributes about a third of the nation's total greenhouse gas emissions. And each sector, in principle, could make equal contributions to reducing those emissions, which are putting the future of the planet at risk. But doing something serious about automobile emissions runs up against America's love affair with the car, and particularly the gas-guzzling SUV. And doing something serious about coal runs up against the immense political power of the midwestern and southeastern coal-burning utilities, an obstacle traditionally believed to be just as high as or even higher than the automotive lobby—though that view may be mistaken.

The coal industry is not in fact the immense political force it was fifty years ago, when the United Mine Workers of America numbered more than a million members and its militant leaders, like John L. Lewis and Phil Murray, could threaten to shut down the U.S. economy if their demands were not met. Today, the UMWA has barely more than 100,000 members, many of them retired.[25] Scarcely 70,000 workers actually mine coal, and a great deal of that is stripped by means of huge machines, operated by a handful of nonunion, highly skilled and highly paid men and women. From this perspective, coal might seem almost a spent political force, the stuff of nostalgic songs sung by aging folk-song performers.

Fom a different perspective, however, the coal industry still exercises almost the same disproportionate sway over the U.S. polity as in the

UMWA's glory days. This is because the big utilities in the Midwest and the Southeast rely on it utterly. They are the nation's (and among the world's) very largest utilities, with names like American Electric Power (the mightiest of them all), Southern Company, Duke Power, and First Energy. AEP, First Energy, and Cinergy all are located in Ohio, where, increasingly, the closely divided nation sees its destiny decided every four years.

Some measure of the utilities' influence and power can be taken from the events that led to the great Midwest–Northeast electricity blackout of August 14, 2003. That event darkened states from Michigan to New York, as well as Canada's Ontario, making it the largest single outage in history. Though the failure was rooted in the deregulation and restructuring of the U.S. power system, which began in earnest in the early 1990s, both the underlying and the proximate causes could be traced mainly to the negligence of one Ohio utility, First Energy.

The immediate chain of events leading to the August 2003 blackout began two years earlier, when the Davis Besse nuclear power plant operated by First Energy, near Toledo, had to be closed down for detailed inspection and reconstruction when unexpectedly severe corrosion was discovered in the vulnerable cap to the reactor core, which is pierced with control rods and fuel rods. Because the situation was so serious—if the corrosion went too far, the reactor's pressurized vessel might burst, releasing vast quantities of radiation into the environment—the Nuclear Regulatory Commission had to order emergency inspection of sixty-nine similar reactors, at considerable expense and inconvenience.[26] Those reactors were found in due course to be all right, but meanwhile, First Energy's Davis Besse plant stayed shuttered, resulting in a shortage of electricity right in the middle of the narrow corridor that connects the midwestern and northeastern power systems.

Beginning early in the afternoon of August 14, big transmission lines began to fail in First Energy's operating area, several because the utility had not kept up with tree-trimming, so that as heavily loaded lines heated up, they sagged into brush and shorted out. As one went down, the next would become too loaded, sag still more, and short, and so on. All that, the result of a serious infringement of operating standards and no small matter in its own right, would have remained a local problem if First Energy and the midwestern power regulator had quickly recognized what was going on and had promptly cut service to enough customers to keep the whole system from getting overload-

ed. But the equipment First Energy needed to monitor and simulate what was going on in its system was out of order, and the situation at a newly established regulator in Indiana was not much better. Six months later, when a U.S.–Canada investigatory team reported on the accident, a list of the ways in which First Energy was seriously unprepared for the events that unfolded on August 14 filled the better part of a page. A second list, of the ways in which the utility had violated standard reliability rules, filled another page.[27] Yet there was no talk of imposing civil or criminal penalties. As if nothing noteworthy had happened, the midwestern and southeastern utilities continued to successfully resist federal legislation that would have made reliability rules mandatory and strengthened the hand of the Federal Energy Regulatory Commission. In particular, they forced FERC to back off from imposing a "standard market design" requiring all U.S. utilities to play by the same set of rules.

And so, if you ask yourself why burning coal continues to kill tens of thousands of Americans each year, why it still causes neurological disorders in hundreds or thousands of children, why it continues to ravage environments from the Smokies to the Tetons, and why it produces 40 percent of U.S. greenhouse gas emissions each year and 10 percent of the whole world's emissions—and if you ask why so little is done about all that—you need look no further than the amazing events of August 2003 and the role Ohio famously plays every four years in each presidential election.

In recent years, however, the alliance of midwestern and southeastern coal-burning utilities has shown signs of fracturing on global warming. In essence the situation is similar to that in the global oil industry, where companies like BP (British Petroleum) and Shell have broken ranks with the mainstream, taking the position that the energy industry is going to have to find ways of weaning the world from carbon-based fuels. Already in the late 1990s, Ohio's AEP, probably the country's largest utility at that time, began to cautiously favor carbon regulation. More recently, James E. Rogers, CEO of Cinergy—the Cincinnati-based utility that emerged as an industry giant in 2005 after merging with Duke Power—has adopted an aggressive public position similar to that taken by BP's Sir John Brown. Both Rogers and Duke CEO Paul Anderson have been saying that global warming is a real and very serious problem, and that energy companies can survive in the long term only by addressing it. With Rogers,

Brown, and Anderson, personal conviction and vision are clearly playing an important part, but ultimately they are acting in what they see as their corporations' self-interest.

Assessment of such interests is a complicated matter. One factor, already mentioned, is that as the United States had adopted strict regulations limiting emissions of sulfur dioxide, utilities burning western low-sulfur coal have had an advantage over the eastern utilities relying heavily on Appalachian coal. But if carbon emissions are regulated as well, the western advantage is partly canceled, because eastern coal burns more efficiently and therefore emits less carbon per unit of electricity generated.

A larger consideration is that as utilities make expensive upgrades to aging coal plants to meet clean air regulations, they worry that if carbon is to be regulated as well, it might make more sense to just replace the plants rather than improve them. Since electricity generated by natural gas is cheaper than coal-generated electricity under most circumstances, and electricity generated by nuclear power plants or wind farms is only marginally more expensive, studies have indicated that if carbon emissions were taxed, a very large fraction of the U.S. coal industry would be promptly shut down.[28]

Last but not least, large institutional investors tend to buy stock in utilities and have an exceptionally large influence on their management. In recent years, many of those institutional investors have been showing up at annual shareholder meetings and demanding that the managers of coal-dependent utilities prepare formal plans for somehow transitioning away from carbon. For example, when shareholders gathered in Tulsa, Oklahoma, in April 2005 for AEP's annual meeting, an activist group warned that the country's number-one carbon emitter risked relinquishing leadership on carbon to Cinergy and Duke. The preceding year, in July 2004, the attorneys general for eight states, including New York, California, Iowa, and Wisconsin, filed suit against a group of energy organizations for producing 10 percent of U.S. carbon emissions: Cinergy, Southern Company, Xcel Energy, AEP, and the Tennessee Valley Authority.

The coal industry's future is hanging in the balance. It should be determined by conscious decisions taken in the broadest public interest.