

The 80% Solution



DANA MILBANK SOUNDED MYSTIFIED, or at least surprised. It was a typically lovely summer day in 2008, and the longtime political reporter for the *Washington Post* had been following NASA's chief climate scientist, James Hansen, as he made the rounds of media and government in Washington, D.C.: Diane Rehm's talk show, congressional committees, and the National Press Club. At age sixty-seven, Hansen, who works in New York City as the director of NASA's Goddard Institute for Space Studies, was a familiar face in the capital. He had been coming to the Hill for at least twenty-five years to talk with bureaucrats, reporters, activists, legislators—indeed, with anyone who would hear him out—and in all that time the core message, while disturbing in its implications, had been remarkably consistent. But today, it seemed to Milbank, the message had developed a distinct new wrinkle. At least the reporter couldn't recall hearing it before.

With his balding head and slow-paced Iowa deadpan, Hansen could have stood in for practically any role in a Thornton Wilder play set in small-town America—repairman, farmer,

high school basketball coach—but the persona was deceptive. For one thing, it masked a world-class intellect. Having begun his career studying the atmosphere of Venus and other planets, Hansen had gone on to apply that expertise to the study of Earth's own atmosphere and had become one of the early pioneers of the ultrasophisticated “general circulation models” that are now the gold standard for supercomputer forecasting of climate change in the United States, Europe, Japan, and elsewhere. His work has won him acclaim within the scientific community, including membership in the elite American Academy of Sciences and award of the Carl-Gustaf Rossby Research Medal, the highest honor bestowed by the American Meteorological Society.

Of course, one would expect NASA's top climatologist to have that sort of résumé. The lack of conscious polish added to Hansen's credibility—and even a charisma of sorts—that had served the scientist well over the years. But even though people were able to see the brilliance behind the self-effacement, what they didn't tend to see was more in the realm of temperament: a distinct proclivity for inductive leaps that made some of Hansen's more cautious colleagues uncomfortable at times. Climate science has always had to struggle in the popular media with the question, If you can't even predict tomorrow's weather, what makes you think you can say anything meaningful whatsoever about conditions at the end of the century? That objection overlooks a simple difference between meteorology and climatology. While both make predictions about Earth's complex atmospheric system, climatology's job is actually easier because it deals not with particular weather events but with long-term trends in temperature, precipitation, and other measurable features. Thus, while neither a predicted temperature rise over

a hundred-year period nor the appearance of a tornado in the next twenty-four-hour period can be predicted with 100 percent accuracy, a forecast about the former can be made with a higher degree of certainty than a forecast about the latter.

Yet even though climate shows greater regularity than weather, climate scientists remain a wary bunch, and Hansen's penchant for bold hypothesizing was unusual. In 1981 he published a paper in *Science* predicting that the 1980s would be an unusually warm decade worldwide and that the 1990s would be even warmer. Both predictions turned out to be correct. In 1988 he told Congress that by the end of the century, unambiguous signals of a warming trend would emerge worldwide out of the general noise of temperature data. In fact, the twelve-year period from 1997 to 2008 included the ten hottest years on record. In 1990 Hansen bet climatologist Hugh Ellsaesser \$100 that one of the following three years would be the hottest on record. Hansen agreed to a tough definition: to be considered "hottest," the year would have to hit new highs on three different planetary measures: land surface temperature, ocean surface temperature, and temperature of the lower atmosphere. Within six months, all three measures broke records, and Ellsaesser had conceded the bet.

None of Hansen's predictions was reckless: all were supported by the models. Yet had the rising temperatures failed to appear, his credibility would have been severely damaged. Among those who had developed a deep respect for Hansen's intuition was physicist Mark Bowen, who believed that the scientist's willingness to go out on a limb derived directly from his commitment to the scientific method. Hansen had written, "The way I look at it, the great fun in science is that you get to reason about how things work, leading you to make predictions

that test your understanding. The predictions that you make had better include some that are wrong or you are not pushing the envelope of scientific understanding.”

In other words, it wasn't so much that Hansen had no concern about ever being wrong—every scientist wants to be right—but that he was driven more by an intense desire to break new ground. This made him surprisingly unperturbed by “climate skeptics,” whom Hansen often credited with having helped him strengthen his theories.* ABC News reporter Bill Blakemore commented, “He’s transparently full of integrity.... You get the feeling that this is a guy to whom it wouldn’t even occur to lie.”

“The work that he did in the seventies, eighties, and nineties was absolutely groundbreaking,” physicist and historian Spencer Werrt told *New Yorker* reporter Elizabeth Kolbert. He added, “It does help to be right.”

A quarter century after Hansen’s original predictions, the reality of global warming and the role of human activity in that warming had become well established within the scientific community. Princeton climatologist Michael Oppenheimer told Kolbert, “I have a whole folder in my drawer labeled ‘Canonical Papers.’ About half of them are Jim’s.”

In 2007 the national science academies of Brazil, Canada, China, France, Germany, Italy, India, Japan, Mexico, Russia, South Africa, the United Kingdom, and the United States

* Hansen himself might actually be the original global warming skeptic, having written his doctoral thesis on a hypothesis about the cause of Venus’s high temperatures that countered the dominant theory of the time. Whereas most scientists (including Carl Sagan) believed that greenhouse gases such as carbon dioxide were responsible for the phenomenon, Hansen attempted to prove that a blanket of fine dust was responsible. Once satellite probes demonstrated that high concentrations of greenhouse gases were indeed present on Venus, Hansen willingly ceded the point.

jointly endorsed the main conclusions of the body of research that Hansen, more than any other single scientist, had been responsible for developing. The thirteen national academies issued the following joint statement: “It is unequivocal that the climate is changing, and it is very likely that this is predominantly caused by the increasing human interference with the atmosphere. These changes will transform the environmental conditions on Earth unless counter-measures are taken.”

Having been vindicated by the course of events, Hansen was not content to rest on his laurels. In accordance with NASA’s stated mission “to understand and protect our home planet,” he had made it his brief to inform policy makers and the public about the consequences of global warming in terms of sea level rise, extreme weather events, drought, and species extinction, in effect conducting a long-running seminar that he continually updated and extended. Going even further, he had led a coordinated research effort by an international assembly of climate scientists to determine the threshold concentration of greenhouse gases that would constitute “dangerous anthropogenic interference with the climate system” and to identify energy strategies that would most effectively avert such dangerous concentrations.

In discussing the results of this new research, Hansen was now back in the public arena, with a message that Dana Milbank, in his column the next day recounting his time with Hansen, described as “rather counterintuitive.” The message wasn’t so much about the contents of the atmosphere or the oceans—the two systems normally studied by climate scientists—but of the Earth’s crust, specifically the fossil fuels contained in that crust.

Up until now, most of the efforts expended by environmentalists and others to limit fossil energy use had focused

on limiting overall emissions, regardless of the source. That made sense. After all, a molecule of carbon dioxide does not know whether it came from the burning of oil, natural gas, or coal. There's no difference between "oil carbon," "natural gas carbon," and "coal carbon."

But now Hansen was maintaining exactly the opposite: not all carbon is created equal; there is a difference. Specifically, Hansen was saying the carbon from oil and gas, despite its ubiquity and despite all the many efforts to limit its emissions—from attempting to legislate fuel efficiency standards to moving consumers away from gas-guzzling SUVs and toward Priuses and other fuel-efficient vehicles—was less important than the carbon from coal, which is mainly used as fuel in power plants.

Milbank summed up the new twist in Hansen's message this way: "[T]he biggest worry isn't what we put in our cars, it's what we put in our power plants." Or, to boil the message down even further:

*Want to stop global warming?
Forget oil and gas.
Stop coal.*

Forget oil and gas? To anyone who had been following the course of energy policy in the United States over the past several decades, beginning with the energy crisis of 1973, which had been triggered by the boycott of the United States organized by the Organization of Petroleum Exporting Countries (OPEC), oil and gas had always been the center of the story. Coal had virtually been ignored.

In fact, to most Americans, "energy crisis" and "oil crisis" had always been nearly synonymous. Now "climate crisis" was the focus of concern, and once again oil was the focus of most people's thinking. Not surprisingly, SUVs, Hummers, and other

gas guzzlers had become the poster villains for environmentalists. For anyone who wanted to demonstrate concern about global warming, driving a Prius had become a badge of merit.

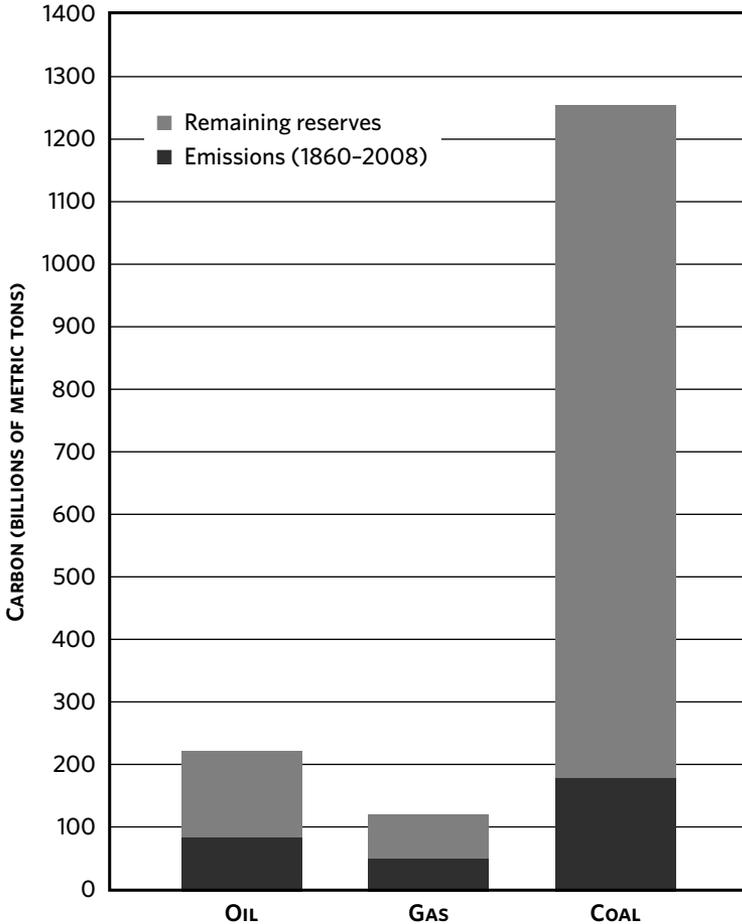
As for coal, most people were barely aware of its role in the mix of energy sources. The word evoked images from an earlier time: railroad steam engines, coal cellars in hundred-year-old houses. Few Americans had ever seen a coal-fired power plant; fewer still had laid eyes on a coal mine. If anything, coal was touted as a savior. With an estimated 29% of world reserves, America was known as the “Saudi Arabia of coal.”

Now Hansen was saying that the abundance of coal, far from being a cause for comfort, was actually our worst problem. In fact, he was willing to put a number on its importance. Ending emissions from coal, he said, “is 80% of the solution to the global warming crisis.”

Hansen’s reasons for emphasizing coal were fourfold:

- **First**, as shown in figure 1, the amount of carbon remaining in the ground in oil and gas reserves is much smaller than the amount of carbon contained in coal reserves.
- **Second**, coal is the most carbon intense of the fossil fuels. Producing a kilowatt-hour of electricity from coal produces about 2.4 pounds of carbon dioxide, while producing a kilowatt-hour of electricity from natural gas produces about 1 pound of carbon dioxide. While coal produces half of the electricity used in the United States, it is responsible for 80 percent of the carbon dioxide released by electric utilities.
- **Third**, coal consumption is far more concentrated than the use of other fossil fuels. A mere six hundred large coal-burning power plants account for nearly all coal usage,

FIGURE 1 HISTORICAL FOSSIL FUEL EMISSIONS AND REMAINING RESERVES



Source: Adapted from James Hansen et al., "Target Atmospheric CO₂: Where Should Humanity Aim?" *Open Atmospheric Science Journal* (2008): page 11. Estimates for remaining oil, gas, and coal reserves are from Intergovernmental Panel on Climate Change, *Climate Change 2001: Mitigation*, B. Metz et al., eds. (New York: Cambridge University Press, 2001).

in contrast to the tens of millions of cars, trucks, planes, homes, businesses, and factories that burn oil and gas. Thus, reducing emissions from coal is a far simpler task.

- **Fourth**, production of oil and gas is primarily located in countries that American domestic energy policy has little or no ability to control. Any reduced consumption by the United States might well be offset by increased consumption in other countries. In contrast, our ability to control the consumption of coal is substantial, since the United States leads the rest of the world in the size of its coal reserves.

It would have been easy to dismiss Hansen if he were the only scientist making such assertions. But numerous other climate scientists backed up the conclusions he was now talking about. For example, he had coauthored his most recent paper, “Target Atmospheric CO₂: Where Should Humanity Aim?” with nine other prominent researchers: Makiko Sato and Pushker Kharecha of NASA and Columbia University, David Beerling of the University of Sheffield, Robert Berner and Mark Paganini of Yale University, Valerie Masson-Delmotte of the University of Versailles, Maureen Raymo of Boston University, Dana L. Royer of Wesleyan University, and James C. Zachos of the University of California. All had joined Hansen in endorsing the paper’s central conclusion:

Present policies, with continued construction of coal-fired power plants without CO₂ capture, suggest that decision-makers do not appreciate the gravity of the situation. We must begin to move now toward the era beyond fossil fuels. Continued growth of greenhouse gas emissions, for just another decade, practically eliminates the possibility of near-term return of atmospheric composition beneath the tipping level for catastrophic effects. The most difficult task, phase-out over the next 20-25 years of coal use that does not capture CO₂, is herculean, yet feasible when compared with the efforts that went into World War II.

The stakes, for all life on the planet, surpass those of any previous crisis. The greatest danger is continued ignorance and denial, which could make tragic consequences unavoidable.

The intensity of the warnings by Hansen and his fellow climate scientists made me recall a brief conversation with a friend, some months earlier. We were in the kitchen of a rental cabin overlooking the Pacific Ocean, having just arrived with two hatchbacks filled to the brim. We were unpacking our bags of bread and vegetables, bottles of wine, chocolate bars and cookies, beach toys, towels, children's storybooks, and all the other things one brings along on a weekend for two families trying to escape the hectic demands of everyday life.

I knew that Michael was an expert on energy and climate and that he worked for the Stockholm Environment Institute, a think tank that advises governments and nonprofit organizations around the world. Beyond that, I had only the vaguest notion of what sort of work he actually did. This was to be a weekend for us to go off with our families and have a little time away from the daily grind, so I didn't expect topics like global warming to be major topic of conversation. But I was curious to know what he had been up to, so I thought I'd ask him a routine question. "How's your climate work going?" I asked.

As he looked at me, I could see him thinking whether to give me the ten-second answer or the thirty-minute answer.

He said, "Most scary things you hear about are probably hype. If you talk to a real expert, you find that journalists have taken something and blown it out of proportion. But with climate it's the opposite. The closer you get to the experts, the more panic you see."

This wasn't the answer I had expected. I thought he'd tell me something more along the lines of "Well, it's a serious problem,

but we're working on it and there've been a lot of breakthroughs." I had thought the climate problem was something very gradual, slow—a remote danger.

I mumbled something like "Hmm, that sounds bad" and then quickly changed the subject to something more pleasant. Despite the alarming message, Michael's words left me unaffected. What could I do about such a massive situation? The scale was simply too big, too overwhelming.

That sense of doomed inevitability stayed with me until I encountered Hansen's prescription for solving climate change. What made Hansen's message about coal compelling was that it not only named the primary *driver* of climate change but also identified a potential *solution*. A paper coauthored by Hansen and fellow climatologist Pushker Kharecha* explored the question of what would happen if coal use was phased out but efforts to rein in oil and gas usage proved unsuccessful. Could we win the climate war if we *just* won the coal war?

Though cautiously framed, the conclusion of Hansen and Kharecha was: *Yes*. Due to the more limited size of remaining oil and gas reserves, the two scientists concluded that atmospheric carbon dioxide levels could potentially peak at somewhere between 422 and 446 parts per million before gradually declining, a scenario that would not prevent all global warming—that possibility is no longer an option—but that might well head off more dangerous outcomes.†

The idea that the climate change could be addressed by something as straightforward as phasing out coal intrigued

* P.A. Kharecha and J.E. Hansen, "Implications of 'Peak Oil' for Atmospheric CO₂ and Climate," *Global Biogeochem. Cycles*, 22, 2008.

† An important caveat was that use of unconventional fossil fuel sources such as tar sands and oil shale would also have to be avoided.

me, since that did not strike me as an impossible goal. In contrast to the self-defeating notion that climate change can not be stopped by any means short of a wholesale dismantling of industrial civilization, Hansen's message could only be described as hopeful and optimistic.

This is doable, I thought. I knew that there are ways to generate electricity that don't involve burning coal. I also knew that besides the paramount danger of climate change, coal has many other problems, from the ravages of strip mining to the health effects of sulfur dioxide and heavy metal emissions. I decided it was time to learn more.

