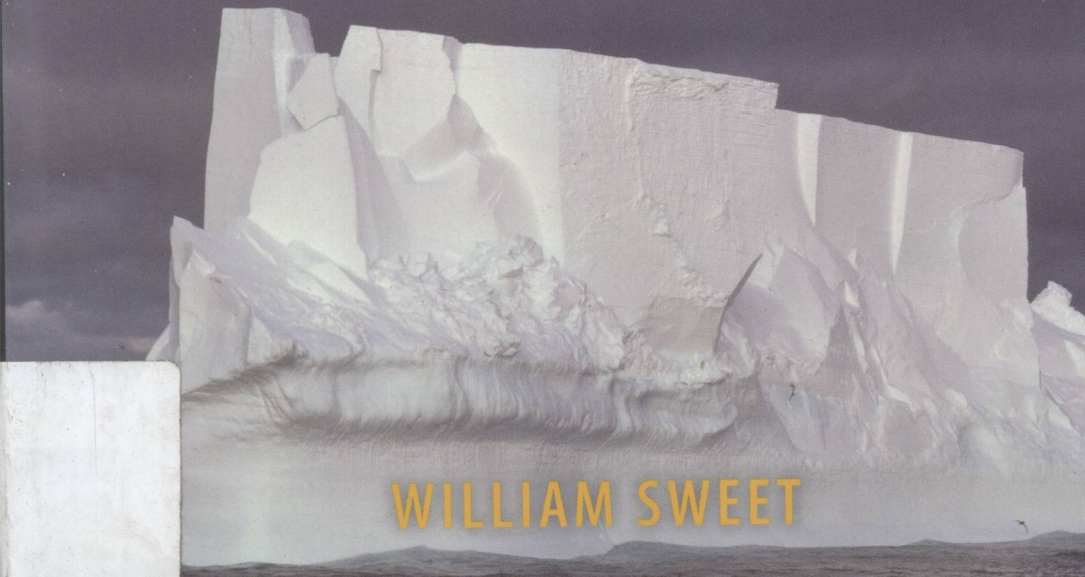
KICKING THE CARBON HABIT

Global Warming and the Case for Renewable *and* Nuclear Energy



WILLIAM SWEET

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This one is for Gail.

PREFACE

This is not a book for those still trying to decide whether or not global warming is a problem worthy of attention, and still less is it a primer or textbook purporting to treat in an evenhanded fashion all significant aspects of the problem. For that, there are plenty of other places to go.[1] Rather, it's assumed that anybody picking the book up already senses that there's something to worry about and would like to know how serious the problem is and whether there's really anything we can do about it. The book is journalistic in that it's based mainly on interviews with leading experts and a close reading of some of what they've written, with a view to conveying the scientific and technical basis of the main concerns about global warming. It tells stories about people, and is written in hopes of being readable, interesting, and even at times somewhat entertaining. But it departs a little from the usual journalistic conventions by also making an unabashed argument, which in the end is solely the author's responsibility.

The main purpose of the book is to get across that there's been a revolution in climate science in the last fifty years—and that we are still a long way from acting adequately on the new knowledge acquired. Though policy is discussed in a global context, the focus is on the United States, because it represents about a quarter of the global problem, because of all the countries in the world, it is in the strongest position to reduce greenhouse gases sharply, and because Americans are the most likely readers.

The book does not necessarily have to be read straight through, start to finish. Readers, depending on their interests and proclivities, can begin with the second or third parts if they are keen to get to the

science or the technology without delay, or even jump around from chapter to chapter. The first part of the book adds up the social and economic benefits and costs of making electricity from coal. The second describes how some pioneering scientists arrived at enormously important conclusions about earth's past and future climate. The third part discusses the low-carbon and zero-carbon technologies that can be deployed on a much larger scale right now to reduce greenhouse gas emissions, as well as some highly touted technologies that are in fact not ready for prime time.

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CHAPTER 1

The Case for Sharply Cutting U.S. Greenhouse Gas Emissions

IN THE EARLY and mid-1990s, a consensus developed among climate scientists that the world was warming alarmingly and that human activity was playing a role. That consensus, very cautiously expressed at first, was the basis of an international agreement for most advanced industrial countries to cut radiation-trapping greenhouse gas emissions to levels about 5 to 10 percent below those prevailing in 1990. Reducing emissions from combustion of critically needed oil, gas, and coal that much was, admittedly, an ambitious goal. But in light of the success the world had had in eliminating the chlorofluorocarbons that were eating up the earth's ozone shield, concerted international action to achieve the goal did not seem unattainable.

In the intervening years, many of the predicted effects of global warming have appeared, often sooner and more disturbingly than most scientists expected. As local habitats have changed in response to changing climates, species of plants and animals have migrated. In some places where they already live in cooler, high-lying areas, they have been climbing ever higher to stay in the only living conditions in which they can survive, but finding there's no place higher to go. Because of such situations, if present trends continue, massive species extinctions are predicted by this century's end. As the world's oceans absorb as much as half the carbon being emitted from human sources, waters are becoming markedly more acidic, threatening fragile corals and all manner of sea life. Meanwhile, Arctic ice has thinned by as much as 40 percent in the last three decades, and all the world's tropical and subtropical

mountain glaciers are fast disappearing. Very soon, Hemingway's snows of Kilimanjaro will be no more.

As the world's oceans warm and expand, sea levels rise, threatening all low-lying coastal areas. At the same time, warmer waters provide fertile breeding grounds for cyclonic storms, which become fiercer.[1] Numerous Pacific islands; the great river deltas along China's east coast, Bangladesh, and nearby regions of India; the coastal areas of Holland, Belgium, and England; and the whole Gulf Coast of North America, from Florida to Mexico, all are severely at risk.

Hurricane Katrina, which devastated the Mississippi and Louisiana coasts in September 2005, flooding 80 percent of New Orleans, provided a vivid demonstration of what's at stake. Of course, no one event can be attributed to global warming, any more than a person's dying from lung cancer can be directly attributed to smoking or air pollution. The relationship is strictly statistical, a matter of probability. But there's little doubt that global warming makes events like Katrina more likely, and when they occur, the costs are staggering. Reconstruction and restoration of New Orleans and neighboring areas will cost the United States hundreds of billions of dollars.

According to one school of thought, we can't afford to take the measures required to curb global warming, and even if we do take them, others, by not going along, will cancel out the good effects of anything we do. This is the wrong way of looking at things. If your house is burning fiercely and neighboring houses are starting to catch fire too, of course you will try to round up your neighbors and get everybody to work together to put out the fires. But if for some reason there are laggards among them, you're not going to waste time trying to get them moving faster. You're going to get to work putting out your fire. It's not a moral issue. Working to protect your home is simply the normal thing to do.

It's not too much to characterize the situation facing the world as a global emergency. The most compelling computer projections, which will be described in detail in the sixth chapter of this book, show that as greenhouse gas levels double, triple, or even quadruple in this century, the wet areas of the world will get still wetter and the dry areas will become even more arid. In some of the great regions that we rely on most for our grains and foodstuffs, agriculture will become unsustainable, because the breadbaskets become too wet or too dry. Meanwhile, as critical infrastructure is put at risk, whole regional economic systems will be jeopardized.

Even worse, the prospect of a supraregional climate cataclysm cannot be ruled out. Paleoclimatologists studying records of earth's climate history preserved in high-altitude cores and ocean sediment—their work is described in detail in chapter 5—have found that whenever greenhouse gas levels were half the world's preindustrial levels, ice ages occurred. The changes in greenhouse gas levels now being induced by human activity are greater than the changes associated with the onset and termination of ice ages. As the levels are rising far above anything experienced and recorded in the last 700,000 years, we are entering wholly uncharted waters, where some kind of large-scale reorganization of the ocean-atmospheric system could occur. With present-day computational technology, we literally have no way of knowing what that might look like.

Given the enormity of the problem, it's easy to see why so many give in to despair, arguing that no effective action is possible. This point of view is found in the climate science community too, where it is not uncommon for those who take the pessimistic view to be also inclined to believe there's nothing to be done, as chapter 7 will show. But there are also those who take heart from progress already made—in reducing chlorofluorocarbons, for example—and who think greenhouse gases can be reined in if their sources are broken down into manageable elements.

In the spirit of thinking globally but acting locally, this book looks squarely at the United States, the world's biggest single source of greenhouse gases and the country best positioned to do something about them. The United States accounts for roughly a quarter of the world's greenhouse gases, about twice the share produced by Japan, Germany, Great Britain, France, and Italy combined.[2] While those five next-largest advanced industrial countries have ratified the international agreement requiring them to get their emissions below 1990 levels and have adopted national energy plans to fulfill that commitment, the United States has not. Since its emissions continue to rise, largely unconstrained by any positive policy, if and when this country finally decides to reverse course, it will have all the further to go.

Fortunately, the United States has a great deal of room for maneuver. It is by far the richest country in the world, in terms of both total income and per capita income. Taking the broadest view of technology, it also has by far the greatest technical resources. Most important, it uses

energy much more extravagantly and carelessly than any other country, which means it can put its vast resources to work effectively to improve production and reduce consumption of energy very fast.

Anybody traveling in Europe in recent decades will have noticed all manner of conservation devices that are virtually unknown in the United States. It starts when you check into your hotel, where hallway lights are on timers and go off soon after you enter your room. The room itself has a key system that guarantees all electrical appliances are turned off when you leave, even if you'd prefer to keep your television and a light on for your return. Use of mass transit is ubiquitous. Gasoline prices are two or three times higher than in the United States, because of taxes, so cars are much smaller on average and people drive them fewer miles.

Of course the United States is a huge, sprawling country, with its own distinct culture, profoundly dependent on automotive transport. Realistically, it cannot be expected to suddenly transform itself into a completely different kind of place. While there no doubt is room for mass transportation to be expanded, Americans never will rely on subways, buses, and intercity trains the way people do in much more compact countries like Japan, Germany, or England. Nor will Americans readily give up their love affair with the automobile. Though some might imagine that we can come to grips with global warming just by persuading people to stop driving huge, gas-guzzling sport utility vehicles (SUVs), perhaps by closing the loophole in fuel-efficiency rules classifying SUVs as "light trucks" rather than cars, it would in fact take draconian measures to achieve automotive fuel savings adequate to the climate challenge facing us.

To get into step with what the other advanced industrial nations are doing to cut their greenhouse gas emissions, the United States needs to reduce its own by at least 25 percent, as soon as possible. The choices that must be made to accomplish that are explored in the third part of this book. To take the extreme case, discussed in chapter 10, if that entire reduction were to be accomplished in the automotive sector alone, Americans would have to accept gasoline prices that are two or three times higher than they are today—or accept rules that simply require them to buy and drive much more fuel-efficient vehicles. Though hybrid-electric cars have enormous promise, unless consumers are forced to buy them by higher fuel prices or legislative requirements, history shows that they will take advantage of standard

vehicles' fuel efficiency to buy higher-performing cars or drive more miles, without achieving any net savings of fuel.

Altogether, the U.S. automotive sector accounts for roughly a third of the country's greenhouse gas emissions and electricity generation from coal for another third, with the rest coming from miscellaneous sources—mainly industrial processes. If only a fraction of the savings needed can come from motor vehicles, then the rest must come from converting the electricity sector to low or zero carbon generation and by conserving energy. Happily, as part 3 shows, this can be done, though some of the choices involved will not please everybody.

Per capita, citizens of the United States use almost twice as much energy as citizens of France, Germany, Italy, Japan, or the United Kingdom. In terms of output produced per amount of energy used, those other advanced industrial countries do about 50 percent better on average.[3] By the same token, the United States currently emits about twice as much greenhouse gas as Japan, Germany, and England, almost four times as much as Sweden, Switzerland, or France, 35 or 40 times as much as China, and nearly 100 times as much as India. Obviously, even allowing for profound differences in infrastructure, culture, and political economy, the United States can do a very great deal to use energy more efficiently and more carefully.[4] By putting the proper incentives into place—a suitable tax or cap on carbon emissions—we should be able to conserve enough energy to prevent electricity demand from growing for the rest of this century.

If at the same time a concerted push is made to sharply cut back on burning coal to generate electricity, a prompt 25 percent cut in carbon emissions ought to be achievable. There is tremendous potential for deploying wind turbines, as countries like Germany and Denmark have shown, even though not all their citizens like to see their landscapes dotted with huge steel towers. (The potential for expansion of solar and wind energy is discussed in chapter 9.) And there is still some room in the United States for replacing coal with natural gas, which is much cleaner and burns much more efficiently, producing only about half as much greenhouse gas per unit of electricity generated. But the United States is exhausting its domestic supplies of natural gas, imports cannot be boosted sharply without building controversial pipelines and liquefied natural gas terminals, and there are many competing uses of the valuable fuel—home heating, the production of chemicals, and even, if fuel cell–powered vehicles become prevalent in a couple of decades,

motor vehicles. Therefore, it is argued in the eleventh chapter, some added reliance on nuclear power also will be necessary; some Americans may have to swallow their distaste for atomic energy and deal with its hazards, just as Europeans have had to accept some unpleasant trade-offs to cut greenhouse gas emissions.

The notion of sharply reducing reliance on coal is, admittedly, counter-intuitive. As radio and television advertisements sponsored by the U.S. coal and energy industries are constantly reminding us, the United States has enough coal reserves to meet all its energy needs for about 250 years. Those ads promise that with new technologies that will give us "clean coal," we can keep relying on coal—and perhaps rely on it even more—without unduly burdening the environment.

The important thing to grasp here is that in terms of carbon emissions, using present-day economically proven technology, there is no such thing as clean coal. Capturing carbon in emissions from coal-generating plants, the way sulfur dioxide and the nitrous oxides are trapped, and then finding a way to safely store huge quantities of the captured substance has not been demonstrated to be commercially viable, as the eighth chapter shows ("Breaking the Carbon Habit"). People in the industry may complain that wind energy or nuclear energy is too expensive, by comparison with coal, to warrant investment. But in fact, it's less expensive to replace a coal-fired electricity generator with a wind farm or a nuclear plant than it would be to capture and sequester the coal plant's carbon emissions.

Some visionary leaders at utilities that currently rely heavily on coal have taken the position that if we're going to impose taxes or caps on carbon emissions, it would be better to do so sooner rather than later. Instead of making expensive upgrades to aging coal plants to meet clean air regulations, only to find themselves having to reduce carbon emissions again later, they'd rather know about those carbon limits right now. That way they have a clear choice to replace rather than upgrade the plant.

We should take those utility executives at their word. Instead of continuing to fight costly political battles over how much and how fast the country's dirtiest coal plants should be improved, we should replace those plants with some combination of wind, gas, and nuclear power. And rather than indulge the fantasy that carbon emissions can be sharply cut by persuading literally hundreds of millions of drivers to

radically change their ways, we should embrace the notion of replacing our 100 or 200 dirtiest coal-fired power plants with superior energy-generation technologies. That is not an inexpensive proposition, to be sure, but it's also not nearly as expensive as it may seem at first glance. Basically, it's like replacing an old clunker that you've driven for a very long time with a much better new car that you expect to also drive for a long time.

But to fully appreciate the force of this argument, we must first add up all the burdens of our present-day coal economy. The first part of this book (chapters 2 through 4) explores the social, economic, and global benefits and costs of burning coal.