*Chapter 2*

# What We Could Do

So if climate change is taking place, will intensify further in the coming years, and will hit us where we live, what can we do? If we accept the findings of scientists about climate change, the path before us is clear: since we human beings are contributing to the problem, we should do as much as we can, as soon as we can, to reduce our contributions to climate change. We should do so on every level: as individuals, families, businesses, industries, states, nations, and the international community. We should use every technology already known to us to reduce our emissions; be inventive in finding, testing, and implementing new technologies; create smart and workable public policies and real-world arrangements to help smooth the transition to new practices; and handle the many historical, cultural, social, economic, and political obstacles to this transition with grace and sensitivity—while moving ahead as quickly as is feasible.

The trouble is that we have not taken these steps with the clarity and dispatch we need. In fact, we have done the opposite. Most nations have continued with business as usual, delayed real action, perhaps taken partial steps at most, and waited for others to sign on before starting up a serious effort. But the climate continues to change, and time is waning. Even as scientists warn us that waiting further could be disastrous, we persist in a resolute inertia.

At this late hour, then, we need to take a double approach to the challenge before us. On one level, we must examine carefully the entire range of measures we could take for reducing the harm we do. To this end, we could rely on those expert guides who explain how to use existing sources of energy more efficiently; how to create, distribute, and use new,

sustainable sources of energy; and how to reduce or end other practices (outside of energy use) that contribute to climate change.[37]

But doing so is not enough. If we are to be honest about what we must do, we need to take into account the obstacles that prevent us from taking action. Even if we have a set of potential strategies in hand, they will not do much good if they are too expensive, take too long to implement, or harm the environment. Furthermore, what will it take to overcome political opposition, to change actual attitudes and behavior, and to inspire action on the vast scale that is required? This aspect of the question is the most crucial, because so far it has proved the toughest to solve.

Accordingly, we have little choice but to examine our potential course of action taking *all* of the relevant factors into account. A thorough, comprehensive look at energy efficiency and technology, however necessary, cannot take us far without an honest appraisal of our collective willingness to act and to change.

Let's start with a basic principle: we simply must shift from our current heavy reliance on oil, coal, and gas to less destructive fuels. Some might argue that the recent shift from oil or coal to the relatively less harmful natural gas is at least a step in the right direction, but it turns out that enough natural gas (or methane) escapes into the atmosphere during the drilling process to cancel out any such benefit.[38] We can't fix anything by shifting from one fossil fuel to another; our only real option is to rely on renewable energy, if we must use energy at all. But at this point we cannot rely very much on alternative sources of energy; a key task is to figure out what technologies might work best and how soon we can implement them.

Several sources of energy are very promising but may simply create more problems than they might solve. Many experts suggest that nuclear power is an excellent long-term option for providing energy at a comparatively small cost in injury to people, footprint on the landscape, and the storage of waste, especially when compared to fossil fuels. But it's clear that creating a new generation of nuclear power plants would be extremely expensive and time-consuming; since few plants are currently in the process of being built and each plant takes roughly a decade to come on line, nuclear power cannot help us right when we must take huge strides toward cutting our emissions. Furthermore, because of the

events at Three Mile Island, Chernobyl, and Fukushima, we all have serious questions about the safety and reliability of nuclear power. Even if the engineering details make nuclear power intriguing, as a real-world matter, implementing it raises too many questions and—even if it should win public approval—would take far too long. It's not a viable option.

Geothermal energy has the great advantages of being inexhaustible, creating no byproducts, remaining constant through time (unlike solar or wind energy), interfering in no natural motion of the winds or tides, and requiring no extraction from the Earth (a claim that not even nuclear power can make, reliant as it is on the mining of uranium). But it, too, requires us to intervene into the Earth's systems, for when we drill some distance beneath the surface, we may risk triggering seismic disruptions, even small earthquakes. A greater problem is that over much of the Earth, bedrock of a sufficiently high temperature (300°) is found very far below the surface; in most of the western half of the United States, for example, geothermal engineers would have to drill down four miles or more, and in most of the eastern half, over six miles.[39] Drilling that deep on a large scale is technically and financially difficult and will be feasible only after a lot more research and testing.

This sort of problem applies not only to alternative forms of energy, but to the possible transformation of our use of fossil fuel as well. Many observers suggest that we cannot rely on renewable sources alone; we will also have to burn coal and natural gas—not as we have done in the past, releasing ruinous quantities of carbon dioxide into the atmosphere, but by capturing and storing it deep in the ground. Although the process of capture and storage will take up part of the energy the plants generate and will thus raise energy costs, at least it will not harm the atmosphere. The real problem in this case—and it's a big one—is that this technology is largely untested; so far not a single coal plant has actually tested carbon capture technology in any serious way. Moreover, just as the Environmental Protection Agency is pondering whether to ban the release of carbon dioxide into the atmosphere from future coal-burning plants in an effort to force them to capture carbon, the low price of increasingly available natural gas is removing incentives for utilities to build such expensive plants at all.[40] Nevertheless, Carbon Engineering has created prototype carbon cleanup systems in Calgary, Alberta,

and now hopes to market its techniques to oil companies and others. Experimentation with this technique is still in its early stages; according to one report, David Keith, the president of this company, "says he thinks it may be possible to lower the cost of capture toward $100 a ton as the company grows."[41] Because the study of this technology is at such an early stage and its potential use so expensive, we cannot presume to rely on it in a large scale in the near future. Yet in his mission to find out how to create an energy system that will reduce greenhouse gas emissions 90 percent in the United Kingdom by 2030, George Monbiot suggests that that nation get half of its power for electricity from plants that burn natural gas (not coal) while using capture and storage technology. Think about it: he's suggesting that *half of the electricity* come from a technology that he admits is *largely untested*. Does that sound like a solid plan to you? But what other choice does he have? Renewable energy of other kinds won't supply enough power to keep Britain going. His dilemma is typical of this entire discussion. We need technologies we do not have, and we need them yesterday.[42]

Luckily, bad news of this sort is not the whole story. Other technologies at first do not seem promising but on a second look turn out to be potentially helpful. Biofuels—fuels created from trees or plants—are technologically viable, but creating an incentive for people to tear out native ecosystems and grow crops to be sold for this purpose—especially in Brazil, where their planting has helped destroy vital ecosystems—undermines the whole purpose of this transition, which is to sustain and enhance the ecosystems we still have.[43] Removing crops for food and replacing them with plants for biofuel can also lower the food supply and raise food prices around the world.[44] A more responsible and sustainable practice of using only waste products or byproducts of farming or forest management might work, if conducted very carefully, but would produce only a fraction of the energy we need.

But a related alternative to biofuels has great promise. Burning the methane emissions from public landfills, sewage plants, and farms addresses two problems at once: it reduces those emissions and transforms them into a locally sustaining form of energy. The technology is readily available; cattle and pig farmers use this technology to burn manure to generate electricity for their own use or for sale back into the

grid.[45] Moreover, it is being used very effectively in Kristianstad, Sweden, which burns biogas from a landfill, sewage ponds, wood waste, and tree prunings, heating homes and businesses without relying on other renewable energies.[46] This technology burns a bit of biofuel along with the gas arising from garbage and waste and may thus provide a good alternative to the more familiar version of biofuel. A municipal biogas plant has the advantage of potentially being under local control: presumably you wouldn't have to move heaven and earth to get a local biogas plant up and running; you'd just have to create the necessary will in your own community. With enough initiative in cities and towns throughout the world, this technology could be implemented widely.

An alternative to geothermal energy also has real merit. Without drilling deep into the Earth, we can still use its warmth as a source of energy. Below five feet or so, the ground has a constant temperature; if you lay a network of pipes in the ground below that depth and run water through those pipes, you can draw the heat from the Earth, concentrate it, put it through a heat exchanger, and use it to warm or cool your house.[47] While the initial cost is high, this source of energy pays for itself in a few years. The largest obstacles to its widespread adoption are public ignorance, the large initial cost, and the lack of trained technicians in many locations throughout the nation.[48] Governments and utilities, however, provide incentives for homeowners to install these systems, and with greater demand, more publicity, and a concerted public effort, people might be able to use this technology throughout the country effectively.

What about solar and wind energy? These have the merit of being familiar to us, but it will take a major effort to supply them in the abundance we require. Our use of these energies is rapidly increasing, their cost continues to fall, and their advantages are becoming clearer to the public as time goes by. But at current rates of implementation, they will contribute only a fraction of energy needs even in a decade or two. Furthermore, since the sun does not shine forever, nor does the wind blow at all times, we can fully use their energies only when we've learned how to store and release the power they provide on demand. A large shift from gasoline-powered to electrical cars would help out in this regard, since the car batteries would serve as an effective form of electrical storage. But for an effective system, we need to create stations to store the

energy these sources provide and relay that energy to consumers on demand. One solution is to pump water into a reservoir when the electricity supply is available, then release the water to flow downhill and generate power when it is needed.[49] These pumped storage facilities—or better alternatives, when they become available—will be necessary components of the overall system. Moreover, to bring these energy sources into a system of sustaining power, we need a smart grid, an updated, high-tech electricity distribution network that can withstand the sudden variations in power provided by the sun or wind, connect all the points in the system, and use the energy contributed by households (from small solar units). In short, we need a lot more than solar panels or wind turbines: we need a new, sophisticated, national grid.

But that is not all. Installing large solar plants will take up huge amounts of open land in the nation's sunny places—land now used by plants, animals, and human beings. Putting in industrial-sized wind turbines on mountaintops, for example, or in promising offshore locations will directly intrude on relatively unharmed ecosystems or pristine vistas. Furthermore, as it turns out, large wind turbines are noisy: they cause a low-level vibration to be heard for a mile or more in the surrounding vicinity. Despite their ability to harness sun and wind for human purposes, these technologies come at a real cost: if we really want to reduce our carbon footprint, we will end up greatly expanding our physical footprint on the land and sea. The reality is that many people will resist these intrusions: the opposition to wind farms around the nation, even from local environmentalists, is substantial. The same will be true once we begin to install industrial-sized solar power plants.

We could, however, decrease the footprint of immense solar power plants by making the generation and use of solar energy an ordinary feature in millions of ordinary households. David Crane and Robert F. Kennedy, Jr., point out that the cost of solar panels has fallen by 80 percent over the past five years and now competes with the cost of the normal electricity supply in twenty states. But few people are choosing it over electricity from the grid because of permitting requirements imposed by state and local governments; complying with those requirements now costs more than the solar equipment itself. If our governments changed

the rules, as the federal government in Germany has done, it would be much easier for people to shift their homes to solar energy.[50]

So how feasible is a large reliance on solar and wind energy? Clearly, we have a lot of work to do. Just building a national smart grid is already a massive infrastructure project; to get it done, we'll need a lot of money, greater technical expertise, and several years of concerted effort. Building a sufficient number of wind and solar farms will also require a lot of advance research, time to put them in place, and a lengthy effort to win public approval. We need key technological breakthroughs to make energy storage cheap and viable. We also need to think carefully about exactly how much of a physical footprint we want to impose on the land and sea for these purposes. But the declining cost of solar energy and the possibility of producing it on the household level may make aspects of this transition easier. Ultimately, these forms of energy could be part of the solution, but they may not be available on a sufficiently large scale and with a truly workable infrastructure for many years.

Let's turn for a moment to another key aspect of the question, the reduction in energy use. As it turns out, industrial electric motors use more energy than highway vehicles. As one energy efficiency expert argues, a wholesale turnover to new, much more efficient motors would cut the energy these machines use in half and pay for the new machines fairly quickly (between a few weeks and sixteen months).[51] New methods of casting metal, new technology for industrial pumps, recycling, and combined heat and power systems (CHP) can each have a major impact: according to the Department of Energy, the widespread use of CHP systems, for example, which recovers otherwise wasted heat, would save the "equivalent to the output of 40 percent of the coal-fired generating plants now producing electricity in the United States."[52] Increasing energy efficiency in homes and buildings, in lighting and appliances, would also save a large share of the energy we now consume.[53] All these transitions use existing technology, would pay for themselves soon, would decrease costs, and are already being implemented by smart businessmen and citizens. In short, this is a no-brainer: reducing energy use in these ways alone would make a serious difference.

But reducing our greenhouse gas emissions involves much more than changing our extraction and use of energy. According to the IPCC,

forestry practices—primarily deforestation—causes just over 17 percent of all our greenhouse gas emissions.[54] Deforestation damages the Earth twice over: it directly releases carbon dioxide *and* damages a forest's long-term role as a carbon sink. Since forests around the world are *already* under severe stress from climate change, as I discussed in chapter one, slashing and burning forests, clear-cutting them, or replacing them with farms or ranches only contributes to an already acute problem. Deforestation will have to end if we are to have the slightest chance of avoiding the worst consequences of climate change. But it is much easier to envision this change than to carry it out. Even if we added the ending of deforestation to the proposed international climate treaties, there is no guarantee that the signatories would actually carry out their obligations. This is a tough one: somehow, we need to create new strategies that will truly stop deforestation.

Most of us intuitively know how we could meet this challenge. We in the developed nations should protect our own forests, of course, but should also pay less wealthy nations for protecting theirs, help them create effective environmental agencies to monitor those ecosystems, and start buying out local farmers and ranchers on the periphery of forests to return recently cleared land to its prior use. In short, we need serious international initiative, political and financial, to make this happen in a way that will matter. The problem, of course, is that funding these measures will require the adoption of an international treaty on climate change, a goal that continues to be elusive, as well as the consent of a majority of voters in developed countries. In some nations, especially the United States, there may not yet be a majority in favor of sending real money overseas to address climate change. It will take many years of hard work to put the necessary agreements in place and to pass the key legislation.

Our use of soils, while the focus of much less public attention, is also crucial. Since the soil contains three or four times as much carbon as plants and trees, tilling the soil—all by itself—can contribute substantially to global warming, for it releases that carbon through erosion and dust. Over most of human history, plowing the land has contributed more carbon to the atmosphere than the burning of fossil fuels; by one estimate, the latter surpassed plowing as a source only in the 1970s.[55] The

mechanization of agriculture, of course, alters the picture; by now, the manufacture of fertilizer and herbicides, the use of fossil fuels to power farm machines, and the release of methane and nitrous oxide into the atmosphere, especially from the application of nitrogen-based fertilizers, makes the situation even worse. The 2007 IPCC assessment estimates that today agriculture contributes around 13.5 percent of greenhouse gas emissions worldwide. Luckily, we already know the basics of how to reverse these practices; according to one study, with smart soil management, the greater use of cover crops, no-till agriculture, manuring, and agro-forestry, we could sequester between 5 and 15 percent of the world's annual fossil-fuel emissions in the soil, transforming a contributor of carbon into a major carbon sink.[56]

But making this shift will require a wholesale transformation in agriculture. In the United States, that's not an industry that yields easily to public pressure, nor is it a political constituency that accepts the urgency of action to save the climate. How exactly are we to bring about the necessary change of attitudes and practices to make a difference? Certainly the federal government could impose new regulations on farm practices or new taxes on certain goods. But farmers could block new rules by litigation or delay new legislation through political pressure. Finding a solution on this one is difficult.

Several patterns emerge from this brief discussion of these questions. For one thing, there are only a few technologies that are ready to go, that can be implemented without difficulty, and that we can build on a sufficient scale to make a real difference. For the most part, new techniques require skills we don't yet have, infrastructure that isn't built, or public approval that will be difficult to gain. As Fred Krupp, President of the Environmental Defense Fund, and Miriam Horn argue, entrepreneurs and inventors are busy creating next-generation technologies that may soon provide solutions to many of our energy needs, but only political intervention to increase the cost of generating greenhouse gases (through the mechanism, for example, of a cap-and-trade system, possibly of the sort that California is now launching) would make it possible for these innovators to generate energy on the scale we require.[57] In a similar vein, Thomas L. Friedman urges the United States to forge into the lead on creating new energy technologies, demanding that our government produce

an "ecosystem for energy innovation" by developing "an intelligently designed *system* of policies, tax incentives and disincentives, and regulations …"[58] But so far, no such system is in place, and as a result the new energy economy has not yet taken off. Some new technologies are available, and in those cases, we should move without delay—to build biogas plants, for example, to shift to a new generation of industrial engines, and to improve efficiencies in our households. But to surmount the difficulty on a vast scale will require enormous political will. Even that is an understatement, since that political will can come from only one place, a huge upwelling of popular support for these changes.

Everything in this discussion thus comes down to the political situation in nations around the world, but especially in America, still the world's dominant economy and one of the leading contributors to climate change, where taking action has proved especially difficult. Yes, the American public believes that human beings are causing climate change by huge margins. But it clearly *hates* any increase in taxes, *even if* a tax is meant to forestall climate change. According to Jon Krosnick, in a poll conducted in early 2009 which found that around 74 percent of the American public thought that global warming was taking place and that it was caused by human activity, majorities of 78 percent and 72 percent, respectively, opposed federal taxes on electricity and gasoline to reduce consumption. But majorities of 80 to 84 percent favored tax breaks of various kinds to encourage renewable energy and energy efficiency.[59] The poll unsurprisingly reflects the public distaste for taxes and love of tax breaks that has been familiar in American politics since the late 1970s. But by sticking with that preference in this case, most citizens choose incremental, piecemeal changes over anything more systematic. They seem to believe that if we improve technology, encourage industries to increase efficiency, and invite people to insulate their homes, we'll be doing fine. Unfortunately, that belief is simply untrue.

We have failed to make progress in shifting to a new energy economy over the last decade because most of us make our decisions according to the laws of the marketplace. We want cheap energy: oil, coal, and gas. The only effective way to change our practice *across the board* is to tax all the sources of greenhouse gas, impose a cap-and-trade system on those sources (as Congress debated in 2009–2010), or create a rationing

system that would supply each citizen with a tradeable set of credits to be used in purchasing fuel in a given year (as proposed by Monbiot).[60]

These ideas are a tough sell to a public that hates taxes. We need an alternative. And luckily, there is one. Several observers have proposed what Steven Stoft calls the carbon "untax"—a tax whose proceeds would be refunded *in full and equally* to every citizen of the United States. This idea has the support of people across the political spectrum, from James Hansen, the leading climate scientist, to N. Gregory Mankiw, who served as George W. Bush's chief economist. It resembles the system in Alaska, whose government returns the state's portion of the proceeds from the sale of oil to every citizen.[61] Other advocates tweak this proposal a bit by suggesting that a portion (perhaps a fourth) of the money raised through the tax be spent funding research and development of renewable technologies. Bill McKibben, a leading environmental writer, likes this proposal; it also served as the basis for the bill sponsored by Senators Maria Cantwell (D-Washington) and Susan Collins (R-Maine) in the 2009–2010 session.

Each of these proposals has strengths and weaknesses. But it is not necessary to consider them at length here. Even with the large majority of Democrats in the first two years of Obama's presidency, the Senate could not act on climate change. Republicans were virtually unanimous in opposition to the cap-and-trade bill, and enough Democrats resisted it in the name of protecting the interests of constituents (such as those in West Virginia, a true coal state) that the bill may never even have had majority support, much less the sixty votes required for passage. That bill was already so riddled with exceptions and special favors, so obviously a series of compromises with the demands of resistant industries, that it may not have been worth passing. But all that is ancient history by now. The "tea party" revolt, the shift in power toward "skeptical" or hesitant Republicans in the 2010 elections, and the enduring resistance of many Democrats make it clear that the necessary political action will not emerge from the U.S. Congress any time soon. In fact, the political realities are and will remain dire. Because the substantial bloc of the public that still repudiates the science of climate change constitutes the base of the Republican party, that party will for many years be held captive by a dogmatic "skepticism," as the 2012 Republican presidential primaries

demonstrated at length. Barring a stunning change in Senate rules, that body will continue to require a supermajority of sixty votes to pass legislation, giving Republicans and resistant Democrats an effective veto on any serious action. There is little cause to hope that the American Congress will ever approve of workable solutions in the absence of a fundamental political realignment of the sort that is highly unlikely to take place anytime soon.[62] The Obama administration, assessing the situation in Congress well, has scaled back its attempts to address climate change in any forceful way and has made clear its preference for fairly modest measures, even after Superstorm Sandy brought renewed attention to climate concerns in the waning days of the 2012 election campaign. Its plans to take action within existing law, through the President's executive authority or the powers of the Environmental Protection Agency, while welcome, can only chip away at the problem rather than bring about the necessary widespread transformation.[63]

That's just the domestic political situation. Things aren't much better internationally. As everyone knows, developing nations refuse to sign on to a climate change treaty without a much more sophisticated understanding of their dilemma, especially of their desire to continue on the path of economic growth and industrial development and their longing to join in the abundance on full display among the wealthy nations.[64] Their hope, in short, is somehow to combine development and greenhouse-gas austerity. Doing so will happen *only* if wealthy nations help them leapfrog over outdated technologies and adopt the most recent, least damaging alternatives—and to preserve their ecosystems as well.

This demand for subsidies, of course, does not go down easy in the developed West. But that is only part of the problem. Most commentators point out that we cannot blame China for its intransigence on climate change, because historically the developed nations have put far more carbon dioxide into the atmosphere than China and because the per capita carbon footprint in China remains far below that in the West. All these points are true. But it does not follow that China's resistance deserves sympathy. For one thing, emitting greenhouse gases into the atmosphere in total ignorance of the consequences, as developed nations have done for a century or two, is quite different from emitting them *now*, when we *know* what those consequences are. We would not countenance

any nation accepting the enslavement of its citizens and justifying the practice by arguing that America once accepted slavery. It is simply unacceptable to use past ignorance to justify present stupidity. Moreover, we should not use the fact that China's per capita carbon footprint remains small to explain why it might be resistant to action: if we do so, we endorse the idea that in all fairness, this footprint *should become larger*—as if developing nations somehow *have the right* to spew huge quantities of greenhouse gases into the atmosphere, simply because *we* have been stupid enough to do so for generations. We can sympathize with their longing for economic growth, but we should *not* submit to liberal guilt. If the rest of the world demands the opportunity to live through the history we have enjoyed, the planet will be toast in short order.

We have to translate China's demands into terms that are just both across nations and to the planet. And justice demands something we may not be able to tolerate: a radical and instant renunciation of what we can now see as extravagant, monstrous stupidity, our willingness to eat the Earth for our own benefit. The point is not to invite the Earth's nations into our greenhouse gas insanity, but to stop *our* insanity and to discover a way of living that is truly sustainable. We should not only make this shift ourselves but also enable developing nations to enter an alternative, more viable modernity as well.

This discussion of the international political scene, of course, takes us right back to the domestic context. Needless to say, the American public has little inkling that such a renunciation is necessary or should even be discussed. The politics of climate change in the United States typically revolves around what we must do domestically to change our practices and whether or how to secure international agreement. But since a workable solution will have to provide substantial subsidies to developing nations, it will also require at least a minimal generosity from American taxpayers *on top* of whatever costs we must pay to transform our *own* energy practices.

It might be plausible to imagine that in a period of robust abundance, Americans could accept both domestic transformation and international generosity at once. But it's hard to imagine that sort of acceptance today. The lingering effects of the Great Recession make aggressive action politically impossible. With high federal debt, state governments recovering

from crisis, and elevated unemployment, the public appetite for renouncing our dependence on fossil fuels is virtually nonexistent. The focus on recession or debt will drown out other priorities for many years—at least until the recovery has brought the country well out of the housing crisis and greatly reduced the unemployment rate. Never mind that the actual costs of the transition for an average citizen would not be very large; with the carbon untax, for example, such a citizen would probably come out *ahead*. Never mind that a substantial subsidy to the developing world wouldn't impose a large burden on the ordinary taxpayer. The problem here is not practical, but psychological; it arises from the difficulty of thinking about distant nations, and a presumably distant future, while in the midst of hard times. In a highly polarized political context, actions that are rather inexpensive can take on huge symbolic significance, for taking those actions requires that we accept a new and perhaps unpalatable view of the world and of our place in it.

For some observers, it may be quite easy to denounce the widespread denial of climate change as well as the overwhelming reluctance to act. But it just won't do to blame others. Those who are often the most passionate about climate change—relatively well-off, educated, and literate citizens—are part of the problem, too. Take the question of airplane travel. Let's say an exemplary citizen recycles scrupulously, drives a fuel-efficient car, eats organic food, and votes for enlightened politicians—but takes three plane trips a year (to see parents in California, to vacation in the Caribbean, or to see friends in New York). It's quite possible that just *one* of those plane trips will have as great a carbon footprint as driving that fuel-efficient car for an entire year. Everybody knows, or should know, that plane travel is a serious indulgence, that it cancels out any environmental responsibility that citizens might otherwise display.[65] But everybody in the middle class or above indulges in it anyway. David MacKay brilliantly juxtaposes two quotations from Tony Blair. In the first, Blair says, "Unless we act now, not some time distant but now, these consequences, disastrous as they are, will be irreversible. So there is nothing more serious, more urgent or more demanding of leadership." Two months later, "responding to the suggestion that he should *show* leadership by not flying to Barbados for holidays," Blair says that this idea is "a bit impractical actually …"[66]

I think most people in the relevant classes can sympathize: nearly everyone who understands what is at stake and can afford to travel really can't *imagine* renouncing the convenience of flying. Let's not point fingers at those other idiots; with few exceptions, we're idiots, too. Blair's reluctance to give up his vacation in Barbados demonstrates quite clearly that political inaction only expresses a reluctance that *all* of us feel to transform our lives fundamentally. However much our minds may be persuaded of the need to act, on a gut level we just can't do it—or can't do it nearly as quickly and thoroughly as the occasion demands. Our experts have long since outlined what we could do to face the present challenge. Slowly and with infinite reluctance, we may be starting to take up the task. But do we have time to spare?

### *Notes*

37. Some of the best examples include Al Gore, *Our Choice: A Plan to Solve the Climate Crisis* (Emmaus, Pennsylvania: Rodale, 2009); George Monbiot, *Heat: How to Stop the Planet from Burning* (initially published 2007; Cambridge, Massachusetts: South End Press, 2009); and David J. C. MacKay, *Sustainable Energy—Without the Hot Air* (Cambridge, England: UIT Cambridge, 2009).

38. Joe Romm, "Bridge to Nowhere? NOAA Confirms High Methane Leakage Rate Up To 9% From Gas Fields, Gutting Climate Benefit," Climate Progress, January 2, 2013, http://thinkprogress.org/climate/2013/01/02/1388021/bridge-to-nowhere-noaa-confirms-high-methane-leakage-rate-up-to-9-from-gas-fields-gutting-climate-benefit/.

39. See the map in Gore, *Our Choice*, 103.

40. Matthew L. Wald, "With Natural Gas Plentiful and Cheap, Carbon Capture Projects Stumble," *New York Times*, May 18, 2012, http://www.nytimes.com/2012/05/19/business/energy-environment/low-natural-gas-prices-threaten-carbon-capture-projects.html.

41. Anne Eisenberg, "Pulling Carbon Dioxide Out of Thin Air," *New York Times*, January 5, 2013, http://www.nytimes.com/2013/01/06/business/pilot-plant-in-the-works-for-carbon-dioxide-cleansing.html.

42. David MacKay, *Sustainable Energy*, differs; in his thought experiment, Britain would not need to rely on power plants of this kind at all. But his suggestions would require a huge increase in the energy-driven footprint on the land and sea.

43. Kosloff, *No Rain in the Amazon*, 145–73.

44. For one example, see Elizabeth Rosenthal, "As Biofuel Demand Grows, So Do Guatemala's Hunger Pangs," *New York Times*, January 5, 2013, http://www.nytimes.com/2013/01/06/science/earth/in-fields-and-markets-guatemalans-feel-squeeze-of-biofuel-demand.html?pagewanted=all.

45. On generating biogas from manure, see Fred Krupp and Miriam Horn, *Earth: The Sequel: The Race to Reinvent Energy and Stop Global Warming* (New York: Norton, 2009), 206–208.

46. Elisabeth Rosenthal, "Using Waste, Swedish City Cuts Its Fossil Fuel Use," *New York Times*, December 10, 2010, http://www.nytimes.com/2010/12/11/science/earth/11fossil.html?pagewanted=all.

47. For a good overview of residential geothermal systems, see U.S. Department of Energy, "Geothermal Heat Pumps," available at the Whole Building Design Guide, http://www.wbdg.org/resources/geothermalheatpumps.php.

48. Patrick J. Hughes, "Geothermal (Ground-Source) Heat Pumps: Market Status, Barriers to Adoption, and Actions to Overcome Barriers," Oak Ridge National Laboratory, U.S. Department of Energy Publications, December, 2008, available as a pdf document online.

49. MacKay, *Sustainable Energy*, 190-94.

50. David Crane and Robert F. Kennedy, Jr., "Solar Panels for Every Home," *New York Times*, December 12, 2012, http://www.nytimes.com/2012/12/13/opinion/solar-panels-for-every-home.html.

51. Amory Lovins and L. Hunter Lovins, *Climate: Making Sense and Making Money*, Old Snowmass, Colorado: Rocky Mountain Institute, online publication, 1997, 6, http://www.rmi.org/Knowledge-Center/Library/C97-13_ClimateSenseMoney. See also the U.S. Department of Energy, Energy Efficiency & Renewable Energy, at http://www.eere.energy.gov/.

52. Gore, *Our Choice*, 253–54.

53. For excellent, detailed estimates of the benefits of energy savings in vehicles, buildings, and households, see MacKay.

54. See the IPCC Fourth Assessment Report (2007), Synthesis Report, 2.1: Causes of Change, http://www.ipcc.ch/publications_and_data/ar4/syr/en/mains2-1.html.

55. Al Gore, *Our Choice*, 203.

56. Rattan Lal, "Soil Carbon Sequestration Impacts on Global Climate Change and Food Security," *Science*, volume 304, number 5677 (June 11, 2004), 1623–1627, doi:10.1126/science.1097396.

57. Krupp and Horn, *Earth: The Sequel*, make this point throughout their book; for example, see 40–44. On the California cap-and-trade launch, see Felicity Barringer, "A Grand Experiment to Rein In Climate Change," *New York Times*, October 13, 2012, http://www.nytimes.com/2012/10/14/science/earth/in-california-a-grand-experiment-to-rein-in-climate-change.html?pagewanted=all.

58. Thomas L. Friedman, *Hot, Flat, and Crowded: Why We Need a Green Revolution—and How It Can Renew America*, Release 2.0 (New York: Farrar, Straus and Giroux, 2009), 293.

59. Jon Krosnick, "The Climate Majority," *New York Times*, June 8, 2010, http://www.nytimes.com/2010/06/09/opinion/09krosnick.html?pagewanted=all&_r=0.

60. For a relevant report on the results of a carbon tax imposed for slightly different reasons, see Elizabeth Rosenthal, "Carbon Taxes Make Ireland Even Greener," *New York Times*, December 27, 2012, http://www.nytimes.com/2012/12/28/science/earth/in-ireland-carbon-taxes-pay-off.html?pagewanted=all.

61. Steven Stoft, *Carbonomics: How to Fix the Climate and Charge It to OPEC* (Nantucket, Massachusetts: Diamond Press, 2008).

62. Of course, if a party with a majority in that body invokes the so-called "nuclear option," eliminates the filibuster or the cloture vote, and thus makes it possible for legislation to pass with a simple majority vote, then a bill addressing climate change might have a chance. But leaders of majority parties have been historically reluctant to take this step, and it's not clear that they would prevail without having a supermajority in hand to do so.

63. See Richard W. Stevenson and John M. Broder, "Speech Gives Climate Goals Center Stage," *New York Times*, January 21, 2013, http://www.nytimes.com/2013/01/22/us/politics/climate-change-prominent-in-obamas-inaugural-address.html.

64. Here and elsewhere I use the language of "development" for several reasons: to avoid using the language of the First and Third World (with its inherently hierarchical notion of geopolitics), to avoid overemphasizing the notion that some nations are wealthy and others poor (since under the pressure of climate change we may have to redefine wealth), and to foreground the concept of development and all it implies (the notion that all nations should imitate modern Western societies and thus should adopt a highly energy-intensive economy).

65. For a discussion of the environmental costs of air travel, see chapter ten.

66. MacKay, *Sustainable Energy*, 222.