The End of Energy

The Unmaking of America's Environment, Security, and Independence

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Harvard sociologist Daniel Bell, who wrote the influential 1970s book *The Cultural Contradictions of Capitalism*, said about Jimmy Carter's crisis-of-confidence speech: "I do not think one can yoke a theme that is primarily moral and cultural to a 'cause' or 'crusade' that is so complex as energy." But that is exactly what we *must* do now. And not just for reasons of morality, but in order to forestall the risks of a genuine disaster.

11 Shock to Trance: The Power of Price

On November 17, 2008, the second Sunday after his election, Barack Obama sat down for an interview with Steve Kroft of CBS's *60 Minutes*. Here is what was said about energy in that conversation:

Kroft When the price of oil was $147 a barrel, there were a lot of spirited and profitable discussions that were held on energy independence; now you've got the price of oil under $60.

Obama Right.

Kroft Doing something about energy, is it less important now that . . . ?

Obama It's more important. It may be a little harder politically, but it's more important.

Kroft Why?

Obama Well, because this has been our pattern. We go from shock to trance. You know, oil prices go up, gas prices at the pump go up, everybody goes into a flurry of activity. And then the prices go back down and suddenly we act like it's not important, and we start, you know, filling up our SUVs again. And as a consequence we never make any progress. It's part of the addiction, all right. That has to be broken. Now is the time to break it.

No one can deny the truth of President Obama's description. When oil prices spike, politicians rush to act; the public scurries to respond to the new situation. When oil prices decline again—as they always have, so far—sighs of relief reverberate through the nation. Old consumption patterns reemerge. During the 1980s and 1990s, the American people entered a long energy policy trance. Relatively low energy prices removed energy from the front policy burner for both presidents George H. W. Bush and Bill Clinton.

The only federal energy legislation of much consequence in the 1990s was the Energy Policy Act of 1992—a response to an oil price shock after Iraq's invasion of Kuwait and the subsequent U.S. attack on Iraq.

There is a difficult dilemma here: higher energy prices may be what we need to achieve energy security and limit climate change, but neither the public nor their political representatives really want these higher prices. On the one hand, higher prices encourage us to consume less energy and emit less carbon dioxide and other greenhouse gases and pollutants, thereby lessening our need to import oil and helping to avoid climate change. On the other hand, they have been associated with recessions, and in the 1970s they were accompanied by a dreadful "stagflation," the debilitating combination of recession and inflation. In addition, high energy prices are especially burdensome for those on fixed incomes or with low incomes. What we want, what we may really need, is clean, reasonably priced, secure domestic energy, but if we are ever going to get that, we will need to learn to live with higher prices for carbon-emitting and imported energy sources, most notably coal and oil. Fortunately, as we have moved from a manufacturing-intensive economy to one based more on services, we have been able to reduce our energy intensity, and we have become better able to cope with higher energy prices.

Prices of oil have long refused to behave as the experts have predicted. Virtually every time oil prices have spiked, energy experts have predicted the increase to be permanent, but then prices have tumbled. Energy projects are typically both capital intensive and long term. Changing our pattern of energy consumption takes time. Porous buildings still leak when heating costs are high. Gas guzzlers get no better mileage as gasoline prices soar. We can cut back the electricity we use by only a little—at least in the short run. When oil prices are high, increasing exploration and investment in alternatives seems wise, but such investments may rapidly turn sour when oil prices fall. And oil price volatility and uncertainty is greater now than ever, due not only to ongoing conflict in the Middle East, but also to the speculative market in oil futures.

The quantity of trades in oil futures on the New York Mercantile Exchange every day is ten times the world's daily oil consumption. Oil is no longer just a fuel; it may also serve as financial protection against declining value in the dollar. Around the world, the total daily trades in oil on paper are often as much as thirty times greater than the consumption of oil in barrels. Fluctuations in oil prices are quick and frequent. They often have little or nothing to do with the fundamental relationships of oil supply and demand. Dramatic price swings and uncertainty about the future of both supply and demand, coupled with the necessity of large long-term capital investments, exacerbate the problems of creating sound policy. Given, then, the enormous power of price to drive patterns of consumption and the private-sector activity that arises to cater to that consumption, how can we harness the price dynamic to create a better, more stable energy future?

One of the few policies virtually all economists agree on is the need for substantially higher taxes on gasoline and other products from fossil fuels. The purpose of such taxes would be to decrease both consumption and carbon emissions, not necessarily to increase government revenues. *Congress could return the revenues to Americans either on a uniform basis to each person or based on income or wages, such as by reducing payroll taxes.*

Economists have long maintained that when the price of a good fails to take into account important "externalities," by which they mean the effects of transactions on people other than just the buyer and the seller, imposing a tax may be appropriate or even necessary. The classic case for such a tax is on a product or process that pollutes. The market price for fossil fuels fails to reflect the costs of its attendant pollution, including not only but especially emissions of carbon dioxide. A tax on carbon would require the producer of the emissions to take into account the costs he is imposing on society.

Market prices also fail to reflect the costs of our dependence on oil imports. In addition to the burdens on the overall economy from sharp price increases at the hands of the OPEC cartel, there are national security costs, such as deploying our military to protect and secure the flow of oil from the Middle East. We also pay a price for transferring enormous sums of dollars to nations that may not always be friendly to us. One researcher has estimated that oil dependence cost our economy between $700 and $800 billion in 2008 alone.

In addition, underpriced commodities tend to be overused. If you want people to consume less of something, taxing it can be a sure-fire tool. With emissions of carbon dioxide becoming the main focus of our policy concerns, a carbon tax should be an obvious policy instrument. Increasing the price of emitting carbon dioxide by taxing carbon would incentivize the

public to consume less fossil fuel, entrepreneurs to invest in alternatives, manufacturers to produce more energy-efficient appliances and automobiles, and builders to construct more energy-efficient buildings. One reason that Europeans drive smaller cars and fewer miles than Americans is that they face much higher gasoline taxes. Gradually increasing the price of using fossil fuels through a tax on carbon would also make cleaner sources of energy more economically appealing, thus spurring innovation and development of these sources. As Al Gore states in *An Inconvenient Truth*, "The easiest, most obvious, and most efficient way to employ the power of the market in solving the climate crisis is to put a price on carbon."

A carbon tax would essentially impose a fee for each ton of carbon dioxide emitted by taxing each ton of carbon contained in fossil fuels. By being imposed directly on fossil fuels, a carbon tax can build administratively on existing excise taxes on coal and petroleum and can be limited to about 3,000 companies, while capturing about 80 percent of U.S. emissions. For modest additional costs, coverage can be extended to almost 90 percent of emissions. Emitters would generally invest in carbon dioxide control measures until they cost more than the tax rate, so setting the rate becomes important. Congress might set the tax rates to rise over time to specified levels and delegate to the EPA the authority to revise the rates if emission-reduction targets fail to be met or as new information becomes available, subject to congressional oversight and review. In Canada, both Quebec and British Columbia have adopted such a tax. In British Columbia, the rates rise from an original rate of $10 a ton of carbon content to $30 by 2012 (equivalent to about 30 cents per gallon of gasoline) with all the tax's revenues returned to residents, in part per capita and in part based on income. Although several members of the U.S. Congress have introduced carbon tax bills, these bills have not gained any real traction. A substantial tax on fossil fuels is one of the few energy policy strategies that we as a nation have consistently failed to employ.

In the 1970s, the Nixon administration announced it was considering a substantial gasoline tax increase, but it quickly dropped the idea. Gerald Ford rejected any increase in gas taxes (although he did propose an oil import fee), despite support from Alan Greenspan, the chairman of the Council of Economic Advisers. And President Ford fired his energy secretary John Sawhill when Sawhill publicly suggested that gasoline taxes be

hiked up to 30 cents a gallon. In Congress in 1975, the House Ways and Means Committee chairman, Oregon Democrat Al Ullman, proposed a substantial gasoline tax increase, but his plan was soundly defeated on the House floor and never even considered in the Senate. In 1977, Jimmy Carter proposed, as part of his comprehensive energy plan engineered by James Schlesinger, increasing the gasoline tax by a nickel a gallon each year for ten years, up to a 50-cent ceiling, for every percentage point that the nation's gasoline consumption exceeded specified national goals. He would have refunded most of the revenues from this "standby gasoline tax" to low-income automobile owners. Despite support from the Democratic leadership in both houses of Congress, this proposal went nowhere. In March 1980, President Carter exercised the authority he had been given by Congress to impose a fee on oil imports, designed to function similarly to a tax on gasoline, but Congress voted overwhelmingly to stop this import fee from ever taking effect. John Anderson, an independent candidate for president in the 1980 election, urged an increase in gasoline taxes of 50 cents a gallon, but he got only about 7 percent of the popular vote. Ironically, in 1983 the famous tax cutter Ronald Reagan signed a gas tax increase of a nickel a gallon to provide additional funds for highway construction and mass transit.

In both 1990 and 1993, Congress came close to imposing a substantial tax on energy consumption, but the motivation then was deficit reduction, not energy policy. In 1990, many observers blamed Congress's failure to enact an energy tax on the fact that oil prices nearly doubled (from $14 a barrel to $24 a barrel between July and September) after Iraq invaded Kuwait. This price spike made it difficult for politicians to pile additional costs onto their constituents. When all was said and done, Congress in 1990 simply increased the federal gasoline tax by another nickel a gallon.

In 1993, when oil prices were again low (having fallen back to about $14 a barrel), President Clinton urged Congress to enact an energy tax—a so-called BTU tax. After much presidential arm twisting, the House of Representatives passed this provision—without garnering a single Republican vote. The BTU tax never got out of the Senate. The legislation finally enacted in 1993 limited the tax to gasoline and diesel fuels and increased the amount by 4.3 cents a gallon, bringing the total federal tax to 18.3 cents for a gallon of gasoline, 24.3 cents for a gallon of diesel. The next

year Republicans won a majority in the House of Representatives for the first time in a generation, and many House Democrats who voted for the BTU tax were not reelected.

In the Senate, as usual, regional politics inhibited sound policy. Higher energy taxes were opposed by a variety of regional interests, ranging from northeastern liberals worried about low-income constituents who burn home heating oil to western conservatives worried about voters who drive long distances. A number of senators, particularly from the Midwest, were concerned about the potential impact of an energy tax on the international competitiveness of energy-intensive manufactured products, such as steel and chemicals. The BTU tax also foundered on the opposition of key senators from the oil-producing states of Louisiana and Oklahoma. It became clear from the Senate's discussions that even if such a tax were enacted, it would be riddled with exceptions and special rates.

Following the attack on the World Trade Center on September 11, 2001, George W. Bush might have rallied public opinion and Congress to support a substantial increase in gasoline taxes, an oil import fee, or perhaps even a broad-based energy tax to fund the military operations he launched in Afghanistan and Iraq. He apparently never even considered such an option, though, preferring to fund those ventures through additional borrowing.

Nor has President Obama any intention of proposing a carbon tax, a gasoline tax, or any other tax to advance his energy policy goals—whatever the merits. On April 16, 2008, debating Hillary Clinton in Philadelphia at a crucial moment in their campaign for the Democratic presidential nomination, Obama pledged not to raise taxes on Americans earning less than $250,000 a year. Hillary Clinton made a similar pledge. One of their interlocutors, ABC's George Stephanopoulos, described this promise as "an absolute, read-my-lips-pledge." By using that phrase, Stephanopoulos was alluding to George H. W. Bush's promise never to raise taxes. When Bush accepted the 1988 Republican nomination for president, he suggested, making his biggest political mistake, that the Democratic Congress would push him to sign a tax increase and his response was: "Read my lips, no new taxes." Two years after that, facing a pressing need to take control of spiraling budget deficits and a Democratic Congress insisting that both tax increases and spending restraint be part of any budget deal, Bush negotiated and signed the 1990 Budget Reconciliation Act, which curtailed government spending and raised taxes. An additional two years later, with a

weak economy, the voters no longer trusted him and denied him reelection. Barack Obama repeated this pledge many times after the Philadelphia debate during the 2008 campaign and even after he took office: no tax increase for any family making less than $250,000 a year. This, of course, would rule out a gasoline tax increase, any broader tax on petroleum fuels and products, or a new carbon tax.

That two liberal Democrats running for president in 2008 felt it necessary to rule out any tax increases except on the "rich" demonstrates the continuing potency of the antitax politics that took hold in our country in the late 1970s. Very few days have turned American politics upside down, but June 6, 1978, was surely one of them. That day—by a nearly two-to-one margin—the people of California added a measure known as Proposition 13 to their state constitution. Proposition 13 limited state property taxes and made it very difficult for the state legislature to raise other taxes. In rejecting calls to be "responsible" by virtually all of their elected representatives, California voters transformed tax increases from merely a dangerous political suggestion into an act courting political suicide. The antitax movement—reflecting widespread antigovernment sentiments—soon struck fear into Democratic politicians and became the linchpin of Republican Party politics. Opposition to tax increases has since been the glue that has held the Republican coalition together, and it has frightened many Democrats into acting much like Republicans on this issue. Grover Norquist, an outspoken leader of the Republican antitax movement, describes taxes as "the central vote-drawing issue." "You win this issue," he says, "you win—over time—all issues." Barack Obama's no-tax-increase pledge deprived his Republican opponent of any advantage on the tax issue; in making it, however, Obama may also have deprived himself of a critical tool for governing—or he made a promise he will have to break.

If you want people to conserve energy, produce energy-efficient products, and move from fossil fuels to less-damaging sources of energy, and if you want, out of political fear, to take energy taxes off the table at the same time, only two other policy options remain: (1) subsidize or mandate the behavior you want to encourage or (2) limit through regulations or mandates the behavior you want to curtail. Let's start with subsidies.

In theory, if the goal were only to substitute more benign fuels for carbon-emitting fuels and not to curtail energy use, a subsidy for the favored

fuel substitutes could work as well as a tax on disfavored fuels. Congress, for example, might either increase the gasoline tax by a dollar a gallon or subsidize alternatives by a dollar for every gallon of gasoline they save. Likewise, Congress might impose a tax of $25 a ton on carbon-emitting fuels or grant a subsidy based on an equivalent amount of carbon dioxide emissions avoided. Either the tax or subsidy approach would decrease the costs of alternatives relative to the prices of oil, coal, and natural gas. In practice, however, taxes and subsidies operate quite differently.

The burdens and benefits created by taxes and subsidies will be different. A tax imposed on the carbon content of fossil fuels, for example, would burden the producers and consumers of carbon-intensive products. It would raise the price of coal-fired electricity, for example, compared to solar, wind, hydro, or nuclear power, which are carbon free. A tax would reduce demand for carbon-emitting products so that people, for example, would drive fewer miles or lower their thermostats, and producers might tend to earn smaller profits. Consumers would face higher prices for much of the electricity, gasoline, or home heating fuels they use (although the revenues from the tax can be returned to the public so that low- and middle-income consumers would not have less money to spend or save). In contrast, the costs of subsidizing alternative sources of energy would be financed by the public at large, and the subsidies would increase the profits of those who produce the favored products and perhaps also lower the costs for those who use them.

Importantly, imposing a tax on disfavored fuels does not create any favorites among cleaner alternatives or among particular technologies. When it comes to subsidies, however, Congress is very much in the business of picking winners and playing favorites. In response to a tax on energy, people may change a wide range of behaviors—such as turning off lights, lowering thermostats, driving less or more slowly, properly inflating tires, and better maintaining their automobiles. As a practical matter, Congress would have a hard time subsidizing each of these activities in anything like an efficient manner. *It is also virtually impossible to design a subsidy so that it does not provide an unnecessary benefit for behavior that people would have done anyway without the subsidy.* Some folks, for example, are going to buy insulation or a more energy-efficient air conditioner or furnace (at least when the old one wears out) without a government subsidy. If half the amount of the favored activity would have occurred without any subsidy,

that doubles the costs of a subsidy without any additional benefits. It is extremely difficult and usually impractical to limit a subsidy to genuinely incremental activity.

Since the 1970s, U.S. policy has been to subsidize the production and consumption of fuels we would like to encourage rather than to tax the use of fuels that we want to discourage. Those subsidies, however, have not been concentrated on R&D of new technologies. For the subsequent three decades, federal spending on energy R&D never again reached its late 1970s peak. In the 1980s, federal R&D spending was dominated by defense. And since the 1990s, health R&D has been the government's priority, although in recent years spending on energy and climate change has rebounded from its 1980s lows. In 1979, energy research funding accounted for 23 percent of the federal R&D budget; in 2008, it was less than 4 percent. Federal R&D spending on renewable energy, for example, increased from less than $1 million a year in 1970 to more than $1.4 billion in 1979, then declined to about 10 percent of that amount ($148 million) in 1990 before starting to grow again. In real dollars, federal energy R&D in 2006 was half its level in 1980. And public and private energy R&D spending combined fell from 10 to 2 percent of federal R&D spending.

Since the turn of this century, Congress has greatly expanded total federal subsidies for energy. According to a comprehensive analysis by the Energy Information Administration, total federal energy subsidies more than doubled (in inflation-adjusted dollars) from $8.2 billion in 1999 to $16.6 billion in 2007, growing by more than 9 percent annually. Subsidies for renewable sources of energy increased from 17 percent to 29 percent of the total, whereas subsidies for natural gas and petroleum declined. Coal subsidies changed very little, accounting for about 6 percent of the total in 2007. The amount of energy subsidies provided in the form of tax breaks more than tripled during the same interval, with $37 billion added in 2008 and 2010, and they now account for about 60 percent of the total. During this same period, total energy consumption in the United States grew by less than 5 percent, and energy production remained relatively flat. The "stimulus bill" of 2009 (the American Recovery and Reinvestment Act) added an additional $60 billion of energy spending, which was intended to be used in a four-month period to bolster economic recovery, making available a total of about $100 billion in federal tax and other incentives for renewable energy and energy-efficiency projects.

Federally financed R&D has a crucial role to play in helping to identify, develop, and induce the private sector to adopt the kinds of technological improvements that may ultimately enable us to shift from oil and coal to more climate-friendly fuels. But the government's spending priorities are not set by scientists and engineers. The essential point is this: any way you compare our subsidies for energy, you will find wide variations in their amounts relative to the fossil fuel savings they yield. Government subsidies are certainly not neutral across products or technologies.

Members of Congress frequently insist on their own personal priorities—directing funds to "individual projects, locations, or institutions" by "earmarking" projects. Between 2003 and 2006, congressional earmarks in Department of Energy programs for energy efficiency, renewable fuels, and electricity production tripled from $46 million to $159 million, with earmarks accounting for about 20 percent of the total 2006 budget. By 2008, congressional earmarks totaled $180 million, with an additional $46 million directed to specifically identified energy projects, including particular biofuel plants and specific green buildings. Earmarks that year took up one-half of the total R&D budget for biomass, one-third for wind, and more than one-quarter for hydrogen projects. The American Academy for the Advancement of Science has lamented that "earmarks eat up whatever increases there are for most energy programs and cut deeply into core R&D programs." Many members of Congress are obviously concerned more with rewarding politically well-connected constituents and contributors than with advancing science or promising technologies.

The tax system, as described earlier, has become more difficult to use for curtailing undesirable behavior. At the same time, however, it has become our politicians' favorite mechanism for transferring benefits and providing subsidies. The political advantages of enacting tax breaks to encourage this or that activity or expenditure are obvious: Republicans in Congress virtually never see a tax cut they will not embrace, and Democrats often view tax benefits as the only way to achieve their policy goals without being tarred as big spenders. As a result, presidents and the Congress have come to use tax breaks the way my mother used chicken soup—as a cure-all for any ill American society faces.

A close look at the tax incentives for changing our nation's energy production and consumption patterns is, however, quite discouraging. In April 2009, the staff of Congress's Joint Committee on Taxation (JCT) published a 120-page pamphlet describing the tax breaks that subsidize energy production and conservation. A 19-page table summarizes roughly 40 different provisions, including tax credits for electricity produced from certain renewable sources; tax benefits for alternative transportation fuels, including ethanol and other biodiesel fuels; tax credits for various means of energy production; a variety of tax breaks for homeowners and businesses to install or produce energy-saving devices; tax credits ranging from $400 to $40,000 for vehicles powered by alternative fuels, including fuel-cell, natural-gas, "clean diesel," electric, and hybrid vehicles; a special credit up to $200,000 for refitting property for alternative fuels; as well as a host of benefits for fossil fuels. The JCT estimated that these provisions would cost a total of about $40 billion for the five-year period from 2008 to 2012.

In an effort to assess how well these subsidies have performed in stimulating alternatives to fossil fuels and the extent to which they involve picked favorites, JCT calculated the value of this mélange of subsidies per million BTUs of fossil fuels that each tax benefit saved. It concluded that the benefits ranged from $1.01 to $8.45 saved per million BTUs. Wind power, for example, saved $2.12; ethanol $5.92. The JCT also compared the tax benefits received by two solar energy plants, one getting eight hours a day of sunlight and the other getting five hours. It concluded that the former costs taxpayers $9.64 per million BTUs of electricity, the latter $15.42.

JCT also estimated the dollar value of tax credits for specific hybrid motor vehicles per million BTUs of fossil fuel saved. It found that in 2006 a GMC pickup truck got $5.60 in credits per million BTUs, a Honda Accord $6.59, and a Toyota Camry $11.49. Economist Martin Sullivan also looked at the tax breaks for hybrid cars and compared tax benefits per gallon of gas saved. He found that the tax benefits ranged, for example, from zero for the Toyota Prius (which gets nothing because of its relative success with consumers), to $5.59 per gallon for the Chevrolet Tahoe, which gets less than half the gas mileage of the Prius.

Tax credits that may appear to be neutral are often not. Current law, for example, provides a tax credit for the production of electricity from renewable carbon-free sources equal to 2.1 cents per kilowatt hour for the first 10 years of production. Tufts University economist Gilbert Metcalf has calculated that this subsidy equals $7.74 per ton of carbon dioxide saved for geothermal energy but $12.28 per ton for wind. Given their different

capacities and production locations, geothermal-generated electricity is more likely to substitute for coal-generated electricity, and wind is more likely to replace natural gas. Because the same amount of electricity emits less than half the greenhouse gas when produced from natural gas than from coal, an equal subsidy based on the amount of electricity produced has quite different effects in terms of greenhouse gas emissions saved.

Using a different methodology, Professor Metcalf also estimated the costs of new break-even investments in 2007 across various energy sources and calculated their effective tax rates as a way of comparing the tax benefits for various energy sources. He found that the effective tax rates ranged from a high of 39 percent for certain coal operations to a low of *minus* 245 percent for production of solar electricity. Generating electricity from natural gas was taxed at an effective rate of 34.4 percent; wind at *minus* 164 percent. In looking at direct federal subsidies that year for various sources of electricity production, the Energy Information Administration also found wide variations—ranging from 25 cents per megawatt hour for natural gas and petroleum liquids to 44 cents for coal, $23.37 for wind, and $24.34 for solar. Coal produced about half of the electricity generated in the United States, whereas solar and wind combined produced less than one percent, so the total federal dollars spent look quite different: $854 million for coal, $742 million for wind, $14 million for solar. Per BTU of energy produced, the subsidy for coal was nearly double that for petroleum liquids and natural gas and about one-sixth that for renewable fuels. This is indefensible. Regardless of who does the calculations or what methodology they use, irrationality abounds—expensive irrationality at that.

The specific numbers reported here are far less important than the fundamental trouble they reflect. It is clear that Congress has chosen to award subsidies—whether in the form of direct spending or tax breaks—in such a way that their costs are often unrelated to the benefits they are intended to produce. At best, decisions about what to subsidize and by how much seem arbitrary and capricious. At worst, they are wasteful and sometimes even nefarious.

Waste occurs whenever technologies that are subsidized or mandated do not match the objectives established for them. Twenty-eight states, for example, have mandated that a specified amount of their electricity must be produced from renewable sources. In 2009, electricity from wind was generally the least expensive way for electric utilities to comply with such

mandates. Wind turbines, however, tend to generate more electricity at night when demand is low than on hot humid afternoons when electricity use is greatest. Electricity does not store readily or at low cost; there are limits to utilities' ability to handle intermittent sources of electric power, especially from small scattered sources, and to distribute power to large cities on the electric grid. Moreover, shutting down coal and nuclear power plants when demand is low is impractical. So the utility simply drops the wholesale price it pays producers to zero when it cannot sell what it is required by law to purchase. During the twelve months ending May 2009, for example, wind electricity prices in West Texas dropped to zero 11 percent of the time. This same thing happened, although less frequently, in California, Illinois, New York, and Ohio.

Even with a price of zero, however, wind producers still get 2.1 cents per kilowatt hour from the federal government. According to *Forbes* magazine, the grid operator in Texas, the Electric Reliability Council of Texas, told wind power developers a few years ago that it could not handle more than 4.5 gigawatts of wind power, even at peak demand. The developers built 8 gigawatts anyway. (A $5 billion upgrade in this transmission system is due to come online in 2013, and it should then be able to deliver wind power to Dallas.) So the wind producers often simply settle for their government subsidies even though no additional electricity is going to homes or businesses.

The "black liquor" scandal is far worse, and it became the most notorious recent instance of the pitfalls of congressional efforts to pick winners and subsidize them. Black liquor is a fuel by-product from the chemical production of wood pulp used in manufacturing paper. It has been used as fuel to power paper mills since the 1930s. In 2007, Congress expanded the definition of alternative fuels eligible for a 50 cents per gallon tax credit to include a wide range of petroleum fuels containing biomass products. Paper companies soon thereafter discovered that by adding some diesel fuel to their black liquor, they could become eligible for billions in tax credits. Instead of reducing the amount of petroleum fuel by substituting a biomass product, they added diesel fuel to the biomass simply to obtain tax credits. The subsidy in this case increased rather than reduced the consumption of products refined from oil. International Paper Company alone received as much as $1 billion in tax credits for the black liquor it used in 2009. Benefits to the U.S. paper industry as a whole may total $8

billon—all due to the industry's inadvertent eligibility for a tax benefit that Congress expected to cost only a total of $100 million when enacted.

One would have thought that once Congress learned of this gambit, it would immediately have stopped it. But when the chairman and ranking member of the Senate Finance Committee threatened to repeal this loophole, a representative of the American Forestry and Paper Association said that revoking the paper companies' eligibility for the credit "could have serious consequences for our companies and our one million employees at a time of unprecedented economic challenges." The International Steelworkers Union agreed. Finally in 2010, Congress ended this game—just a particularly costly and egregious example of Congress's inability to target subsidies to genuinely incremental productive and beneficial activities as well as its inability to respond promptly even when it learns that a subsidy has gone badly astray.

Despite the shortcomings of current subsidies—whether in the form of direct spending or tax breaks—government-sponsored or favored *research* will be necessary to assist in the development and commercialization of clean sources of energy. Opportunities for progress abound, including, for example, the potential for algae or other plants to remove carbon from the air, carbon capture and storage at coal-fired electricity plants, new fuels for transportation vehicles, fuel cell technologies, a "smart grid" for electricity, increased efficiency for wind and solar power, lighting from semiconductors (light-emitting diode, or LED, lighting), and a new generation of nuclear power plants, to name just a few. The federal government will clearly have to provide substantial resources for these efforts, although experts do not agree on the total amounts that will be needed.

I do not describe here these technologies in detail or evaluate their relative potential. Some are long shots; for others, the technology already exists, but the underlying economics are quite adverse absent major technological improvements. One important lesson from our 1970s experience is that pursuing a diverse portfolio of technological options and seeking more neutrality among them are essential.

Consider, for example, carbon dioxide capture and storage. We currently have the technological ability to do this, and a handful of small carbon-sequestration projects already exist. As of the summer of 2010, however, no commercial-scale power plant in the world captured and sequestered its carbon emissions. Doing so is very expensive and requires additional

energy to accomplish. The carbon must first be "captured," often through a gasification process, then transported, usually by pipeline, to an underground facility where it will be stored, one hopes, without the potential to escape. In 2003, the U.S. government announced the bold $1 billion FutureGen program—a joint public-private endeavor between the Department of Energy and the FutureGen Industrial Alliance, a nonprofit organization of large coal producers and electric utilities, to build and operate the world's first coal-fired, zero-emission electric power plant. By mid-2007, the Department of Energy, concerned about the rising costs for the plant, retreated and announced a major restructuring of the program to demonstrate carbon-capture and storage facilities at a number of existing and new coal-fired power plants around the country. In June 2009, the new energy secretary, Steven Chu, said that the first commercial-scale, carbon-capture and sequestration plant would be built, after all, in Mattoon, Illinois, and would be funded with $1.1 billion of federal money and the remainder from private sources.

Coal now produces half of the electricity in the United States, and a move away from coal would be potentially devastating to the industry—an industry that has great sway in Congress and that seems to enjoy political protections that outstrip its real value to the country. Putting carbon-capture and storage technology in place might keep up to half of all emissions from electric power plants from reaching the atmosphere, so commercialization and international development of such a process might have a large potential worldwide beneficial impact for coal-fired power plants. But getting to such a result will not happen quickly, if it happens at all. The stakes of such decisions—especially for the coal industry—are quite high. There is a real danger that carbon capture and storage may become the synfuels misadventure of this era, so we should not go "all in" on this bet. We need to pursue many other avenues simultaneously, including developing alternative sources of energy supply and increasing the energy efficiency of the buildings we inhabit and the products we use. Surely we are better off when the allocation of funds to such projects is determined by an independent panel of experts rather than by our political representatives.

During the 1970s, presidents viewed committing the nation to a particular major technological project as proof of their vision and determination. But the most comprehensive analysis of government energy R&D

efforts in the 1970s, a book aptly titled *The Technology Pork Barrel*, concludes that the biggest R&D efforts of that period—the breeder-reactor and synfuels projects—were "unambiguous failures" and that our overall energy R&D effort was "hardly a success." Only the efforts to develop better and more economical photovoltaics for solar power garnered even passing marks from the authors. The biggest problems have been the tendency for Congress to put geographic considerations above technological and economic prospects—along with a pattern of boom-and-bust financing, characterized by a debilitating combination of excessive optimism about technological developments, impatience for results, and a process of haste and waste. The synfuels program, for example, favored eastern over western coal for political, not technological, reasons. The more recent FutureGen project suffered stops and restarts mainly because of undue optimism at the outset about both its costs and performance. Political power in the Congress has long been a critical determinant of where the public's money is spent.

Analysts of energy R&D efforts, whether past or present, agree that major institutional changes are required if we are to be more successful this time around. Elimination of earmarks would be a useful first step, and multiyear budgeting for greater funding stability a second. Congress's diffuse and overlapping committee structure is a fundamental problem, some say perhaps even "dooming the enterprise to failure," but that structure will be very difficult to change. Even within the executive branch, new arrangements are necessary, including payments linked to progress, peer review by independent scientists and engineers, and perhaps new ways of scientifically evaluating research proposals and for financing and assessing the progress of the implementation of new technologies. Encouraging more private investment and production will also be important to bring new technologies to scale. We must be able to pursue a number of paths simultaneously.

At all events, much greater neutrality in the incentives for technological innovations and commercial development is necessary. Trying to pick winners and avoid losers has proved to be a fool's errand. Because the problem of climate change is global, new international arrangements for the development of promising technological advances and cooperation among nations, including especially China and India, will surely be needed. We can certainly do much better than the hodgepodge of subsidies and

tax benefits Congress has enacted so far to encourage energy technologies and alternatives.

It is clear, however, that funding incentives to increase the supply of alternatives to fossil fuels will not suffice alone either to achieve greater independence from imports or to decrease greenhouse gas emissions. Public policy must also curb our demand for fossil fuels. Such a curb will inevitably require higher energy prices for them. A 2009 report by the Energy Technology Innovation Group at Harvard said that "the most important single step toward commercialization of low-carbon technologies is to put a price on carbon emissions." A substantial tax on carbon and on gasoline and other petroleum products—with the tax's revenues automatically returned to the American people to ease the potential burdens on low- and moderate-income families and to minimize any adverse economic effects from imposing the tax—would be neutral toward alternative technologies and surely would help us to achieve our goals. Our experience in the 1970s teaches well the importance of prices to economic and policy developments. And we have long been aware of taxes' ability to amplify price signals and encourage producers to take into account the full range of their actions' costs. Yet we have eschewed taxes and instead employed virtually every other policy tool imaginable. Handing out tens of billions of dollars in subsidies annually is far more seductive to politicians. But our political representatives know that subsidies alone are not likely to accomplish major reductions in either oil imports or greenhouse gas emissions, so they will also attempt to reduce our demand for fossil fuels and control our behavior through those other great levers of government: mandates and regulations.

12 The Invisible Hand? Regulation and the Rise of Cap and Trade

Before the 1970s, the federal government played only a bit part in regulating energy policymaking. The most important agencies were state entities, such as the Oklahoma Commerce Commission and the Texas Railroad Commission, which had the power to regulate oil production in their states. Their job was largely to manage abundance. In effect, they limited output so as not to exceed domestic consumption, although there were times when efforts by the states fell short, and the Interior Department had to intervene to prevent supplies from outstripping demand. Nevertheless, federal policy consisted mostly of the FPC's regulation of interstate natural gas, the AEC's insistent promotion of nuclear power, the licensing and building of dams for hydroelectric power, and the leasing of federal lands for exploration of oil and natural gas.

Oil was inexpensive and plentiful. Virtually no one gave a thought to potential scarcity. Recall Richard Nixon's refusal to accept the shah of Iran's 1969 offer to sell the United States a million barrels of oil a day for a decade for $1 a barrel. Our most conspicuous policy toward oil was the import quota adopted by Dwight Eisenhower to keep foreign oil out of the country. Limiting imports kept oil prices high enough to satisfy the oil companies but, because of oil's abundance and low price, not so high to make consumers fret. Along with a series of tax breaks for oil and gas exploration and production (of which the oil-depletion allowance was the most famous but not the most important), the quota kept our domestic oil producers happy—some might say fat and happy. The main effect of the quota policy was that we used up our own oil when it was cheap rather than devouring Middle East and Venezuelan oil when it was much cheaper. We have been paying the price for that mistake ever since.

Following the 1973 OPEC embargo, all this changed. As previous chapters have described, facing an ongoing national trauma, the federal government, under three presidents, threw itself into the field of energy policy and regulation. By 1980—after promulgating many thousands of pages of new laws and regulations—the national government had entered into every nook and cranny of our nation's energy policy, and federal regulations affected virtually all aspects of energy production and consumption.

Nevertheless, states continued to play an important role in further regulating our various sources and uses of power, sometimes to standards higher than those of the federal government. California, for example, in the 1970s began requiring energy-efficiency minimums for appliances and certain other products. After Florida and some other states joined in or threatened to do so, manufacturers became fearful that they might have to meet 50 different state standards and, seeing that they could not thwart this movement, began to press for uniform federal standards that they could handle. In 1974, Congress required the Department of Energy to set specific energy-efficiency standards for 13 household appliances and heating and cooling equipment, but the Energy Department dithered, and the Reagan administration refused to implement any rules. Congress responded in 1987 by passing the National Appliance Energy Conservation Act, which not only set national standards for appliances, but also imposed deadlines for the Energy Department to promulgate specific rules. In 1992, Congress extended energy-efficiency mandates to some lighting products and certain industrial and commercial technologies. Efficiency standards were further extended and tightened by more recent legislation. And the states continue to be active, with California remaining the most aggressive—now regulating flat-screen televisions, to give just one example.

The CAFE standards are merely the best known of the many energy mandates that firms and families face. Just walk around your house. The energy efficiency of virtually every large appliance and many small ones is now dictated by the federal government: refrigerators and freezers, clothes washers and dryers, dishwashers, hot-water heaters and gas furnaces, to name just a few. And commercial and industrial businesses also now face numerous specific federal energy requirements.

Proponents of such standards often claim very large benefits for them by assuming that no progress in energy efficiency would have occurred if the government had not required improvements. Detractors, however, claim that most of the energy-efficiency increases would have occurred anyway after energy prices spiked in the 1970s and that the mandates result in unnecessary costs, especially to low- and middle-income consumers. Standards have clearly had some effect. Refrigerators, for example, became 75 percent more efficient between 1972 and 2005. And because of tough requirements, California's per capita electricity use has remained relatively level over the past three decades, whereas the rest of the nation's has risen by nearly 50 percent. But California's higher electricity prices, smaller houses, and favorable climate have no doubt also contributed to that result.

Efficiency standards have been criticized for dealing with specific appliances (such as electric hot-water heaters) rather than with equipment that performs similar functions (all hot-water heaters). And updating standards over time is a slow, painstaking process that often involves much negotiation between manufacturers and regulators. Nevertheless, mandatory standards have become commonplace throughout the world and have frequently been buttressed by "strong voluntary programs," such as the EPA's Energy Star labeling program, which requires, for example, power-management "sleep" programs for computers when they have been inactive for a while.

As previous chapters have shown, energy production and consumption in the United States was dramatically affected when in the 1970s the environmental movement found its national voice, and Congress responded with a burst of environmental legislation, followed by many regulations and much litigation. The 1970 enactment of NEPA and the Clean Air Act as well as the creation of the EPA that year—all adopted at a time when the economy was strong and both inflation and unemployment were low—forged an unbreakable marriage of energy policy and environmental policy. This marriage has not always been a happy one. Stresses and strains between the two have been common, but energy policy and environmental policy are—and forever will be—closely bound together. Since climate change moved to the forefront of our nation's environmental and energy policy agendas, the overlap has become greater than ever.

In the beginning, much environmental authority was left to state governments: indeed, the 1970 Clean Air Act explicitly said that air pollution control was the "primary responsibility" of states and local governments. But although the states, especially California, have continued to exercise

power over such issues, more and more control has over time gravitated to the federal government. As we have seen, Richard Nixon, who might not be mentioned in the first rank of environmentalists, elevated environmental protection to the forefront of the national agenda. And even after the economy had deteriorated, amendments to the Clean Air Act in 1977 reaffirmed and strengthened federal regulatory power over our nation's quest for cleaner air.

Virtually all of the federal and state regulations of the 1970s were of the "command-and-control" sort. Congress, the Energy Department, the EPA, and state authorities told producers and manufacturers exactly what level of emissions would be permissible and frequently also what kind of technology must be employed to attain the regulatory goals. Under the 1970 Clean Air Act, for example, federal regulators set air-quality standards for particular regions of the country, with state and local authorities then generally required to tell individual polluters what they must do so that the region's goals would be met. (In some circumstances, the federal regulators told polluters directly what limitations applied to their emissions.)

Throughout that decade, such "command-and-control" regulations came to be increasingly criticized as wasteful, expensive, and ineffective. Delays in updating and ossification complaints became commonplace. And litigation flourished, though with decidedly mixed results. Congress and the EPA also frequently loosened and postponed the standards they had originally set. For example, under the 1970 Clean Air Act, automobile emissions of carbon monoxide and nitrous oxide were required to be reduced for new cars by 90 percent of their 1970 levels within five years. Automobile manufacturers soon insisted that this goal was impossible to meet, and neither the EPA nor environmentalists could demonstrate that the manufacturers were wrong. By 1977, Congress had lowered the standards to achieve about 50 percent reductions and had twice extended the deadline so that even this reduction was delayed until 1981. EPA enforcement actions frequently resulted in promises by industries to comply "sometime" or "pretty soon."

In the meanwhile, academic economists and other commentators were urging alternatives to command-and-control regulation. As the previous chapter has described, one of these alternatives was to impose taxes on the offending pollutant, but politicians rarely endorsed such taxes. A politically more palatable alternative to taxes—and to command-and-control

regulation—then emerged: a market-based regulatory regime known as "cap and trade."

Here's how cap and trade works. Congress (or the EPA) determines what volume of emissions of a particular pollutant will be permitted. In the case of climate change, the emissions concerned would be emissions of specific greenhouse gases in the United States, most important carbon dioxide. The government then issues transferable allowances to emit a specified quantity of the restricted substance or substances. For example, it might issue permits to emit one ton of carbon dioxide in any particular year, with the total number of permits adding up to that year's total permissible emissions. These emissions permits or allowances may either be sold—auctioned—by the government or given away, and they can be used by their owners or sold to others. The fundamental idea is that sales (or "trades") of the permits will operate to concentrate their ownership in those companies that find it most expensive to curb emissions. Companies that can reduce or eliminate their emissions more cheaply than the price of the permits will do so and will sell their excess allowances to others who would otherwise have to spend more than the permits' price in order to curb their own emissions. In this way, market transactions allow emissions to be reduced in the least costly way and avoid the wasteful additional costs that would occur under command-and-control regulations that require each company to limit its own emissions to a government-specified level. Allowances will typically apply only for a specific time period, so this process of buying and selling permits will be repeated over time. By providing financial incentives for the largest reductions in emissions to be made by those firms that are able to reduce their emissions most cheaply, a cap-and-trade system should allow whatever level of total reduction in emissions is specified by the government to be achieved at the lowest total costs.

A carbon tax would have similar cost-saving attributes because each firm would reduce emissions to the point where it becomes cheaper to pay the tax. As chapter 11 describes, the challenge is to set tax rates at the right amount to get the desired overall level of emissions. Taxing greenhouse gas emissions, therefore, might require the taxing authorities to change the tax rates over time if and when total emissions fail to fall to the desired level. With a tax, the price of emissions is fixed by the government, but when the quantity of emissions is set through a cap-and-trade regime, price changes will occur through the emissions permit market. With a tax, if

new information about the science of climate change or its potential consequences emerges, the tax rate may need to be changed; in a cap-and-trade system, the government would instead have to vary the quantity of emissions permits—the cap. If the government changes its targets or the number of permits because of new scientific evidence, new technologies, or changes in the economy, the price of emission permits will also change. Under a carbon tax, emitters would limit emissions whenever the costs of doing so are lower than the tax rate; under cap and trade, these reductions would occur until their costs exceed the market price of purchasing allowances.

Many economists prefer controlling prices through taxes rather than controlling quantities through cap and trade because of taxes' greater predictability, lower volatility, and lesser administrative costs. (The cost of a tax is predictable for the upcoming years; the prices of emission allowances in the open market are not.) Many businesses, despite their general aversion to taxes, also interestingly prefer a carbon tax over cap and trade because of the greater price certainty and smaller compliance costs the tax provides. But environmentalists, regulators, and politicians approach environmental problems through their concerns with a given quantity of emissions, so they find regulatory caps more congenial, especially because they are unsure how firms will react to specific levels of taxation. Close analysis, however, reveals that a carbon tax and a cap-and-trade system can be designed to reach very similar results.

In principle, the older model of direct government regulation of emissions can achieve results similar to a carbon tax or cap-and-trade system by requiring specific but different firm-by-firm emissions reductions. The regulator, however, would need detailed information about the emission-reduction costs for every firm and the lowest-cost technological changes to employ. In practice, this kind of information is not available to the government, and, without it, command-and-control regulation may be unnecessarily expensive (as the Clean Water Act has amply demonstrated).

For example, it became clear not long after the Clean Air Act's passage that meeting the legislation's goals might prove very costly to the nation's economy. In those regions of the country where the improvements of air quality mandated by the act were not occurring—"nonattainment" regions in the language of the law—the EPA sometimes prohibited entry by any new businesses that would emit the specified pollutants until the standards had been satisfied. Needless to say, the prospect of turning away new

businesses did not sit well with the nonattainment areas' residents or their political representatives. Nor would prohibiting new businesses from entering serve innovation, competition, or economic growth. So the EPA began to look for alternatives.

Confronting this problem of the inefficiency of command regulation, academic economists, beginning in the late 1960s, began advocating "market-based" alternatives—such as pollution taxes and cap and trade. By the mid-1970s, the cost-reducing advantages of such alternatives had become clearly demonstrated in the economics literature and rather widely known in policymaking circles. But the EPA moved quite cautiously. Environmentalists were reluctant to embrace the idea of tradable permits because of moral qualms about creating a market for licenses to pollute. Some observers viewed creating a market for pollution rights as equivalent to the Catholic Church's discredited practice of selling indulgences—paying to pollute as forgiveness for bad behavior. Nevertheless, in 1974 the EPA instituted an emissions-trading program that would become a precursor to cap and trade and by doing so initiated a revolution in regulatory practices.

Beginning in 1974, EPA rewarded firms that had voluntarily reduced emissions below the level required by the Clean Air Act with "emissions-reduction credits." The firms could use these credits to allow greater emissions at another regulated source, or it could "bank" them for use in future years. Three years later the EPA began allowing firms to trade these credits to other firms within their region. New firms were then allowed to enter nonattainment areas if they could acquire enough credits from other firms so that they could show that the total emissions in the region would be lower than would otherwise have been the case. In other words, new firms had to buy more credits than their emissions would require. One economist has estimated that by the mid-1980s these emissions credit programs had saved more than $400 million in aggregate compliance costs.

The EPA soon fully embraced a market-based pollution-control methodology in connection with a program to phase out the use of lead as a gasoline additive. The agency allowed those refineries that had outperformed their legal requirements to sell "credits" to refiners for whom removing lead was more costly. Subsequent analyses showed that refiners' ability to trade credits in this manner resulted in less costly and faster removal of lead from gasoline than would have occurred without the

trading option. Although extremely successful on a nationwide basis, the trading of credits produced significant regional differences. Some areas of the country, where removing lead was less costly, achieved greater lead removal—along with its accompanying health benefits—sooner than had been anticipated; others, where less-efficient refiners purchased permits, got the lead out more slowly.

A version of cap and trade was again employed in the case of ozone-depleting chemicals. Pursuant to an international agreement to reduce and eliminate many of those pollutants, the United States in the late 1980s instituted both a tradable permit system and an environmental tax. In a move that prefigured the climate change debate, the EPA decided to allocate permits to use such chemicals without any fee to the small number of domestic producers of these chemicals. It was estimated that this decision produced billions of dollars of windfall profits for these companies relative to what they would have earned had the use of the offending chemicals simply been phased out. In reaction, Congress enacted a complex excise tax on all offending chemicals as a way both to encourage the switch to less-harmful products and to recover some of the profits resulting from using the permits during the phaseout of the pollutants. In retrospect, some analysts have concluded that the tax was ultimately more effective than the tradable permit system in achieving the desired reductions.

Even as cap and trade, with its cost-saving advantages over command-and-control regulation, has emerged over time as the favored regulatory approach for addressing environmental problems, there has been considerable reluctance to transform preexisting regulatory structures. Take, for example, the CAFE fuel-efficiency standards enacted in 1975 and phased in during the following decade. Even though the automotive industry took massive advantage of the "light truck" loophole (read "SUV"), resulting in the number of light trucks growing by two and a half times between 1979 and 1999, from 22 percent of the nation's motor vehicle fleet to 37 percent, Congress wasted 30 years before finally revising the CAFE rules in the Energy Independence and Security Act of 2007. The new rules prescribe fuel standards covering both light trucks and automobiles, and, beginning in 2011, they require average fuel economy to increase to 35 miles per gallon by 2020. In 2009, President Obama accelerated the required fuel mileage improvements, announcing that a new standard of 35.5 miles per gallon must be reached by 2016.

This recent attention to CAFE reflects both the renewed interest in reducing oil imports and the increased political salience of the climate change risks from greenhouse gas emissions. But serious shortcomings remain. Unlike a gasoline tax, the CAFE standards impose no burden on increases in miles driven (total passenger vehicle miles have tripled in the United States since 1975). Nor has Congress ever taken seriously the idea of making gas mileage allowances tradable among automobile manufacturers as a way to achieve our overall fuel-economy goals at lower costs. A cap-and-trade CAFE regime would permit automobile manufacturers who are most efficient at increasing gas mileage to sell excess credits to firms that find increasing the mileage of their vehicles more costly, thus bringing down the total costs to manufacturers in complying with the standards. In the 1970s, when CAFE was first instituted, for example, such a system would have greatly reduced the incentives for Japanese car companies to develop larger cars, such as the Lexus and Infiniti. And now, at a time when U.S. automobile companies face serious economic difficulties and challenges, lowering the costs of complying with CAFE would be no small improvement. But not even the U.S. automobile companies have ever urged such a change, nor has any enterprising member of Congress. This kind of inertia no doubt reflects the tendency of institutional structures, once enacted, to persevere. Today's requirements depend largely on how legislation was fashioned more than three decades ago. The status quo is difficult to overcome, and the tendency of policies to stick with their initial institutional arrangements greatly raises the stakes of initial enactments.

A different piece of environmental legislation that did adopt a cap-and-trade system has proved quite successful. In 1990, Congress amended the Clean Air Act to institute a pollution permit–trading program beginning in 1996 to tackle the problem of acid rain caused by emissions from coal-fired electric utilities. This law was designed to reduce sulfur dioxide levels over time by 10 million tons and nitrogen oxide by 2 million tons. Congress allocated the tradable permits—again without any fee—to facilities at 110 power plants, owned and operated by 61 electric companies, mostly east of the Mississippi River. After 1995, these utilities could emit only the amount of sulfur dioxide that they had permits for. Fines of more than $2,500 per ton of emissions in excess of those allowable are imposed on plants not in compliance. In accepting the market-based cap-and-trade technique, Congress broke a legislative logjam that had prevented it from

dealing with the acid rain problem for more than a decade. The Government Accountability Office has estimated that cap and trade has saved business more than half the costs (up to $3 billion a year) of command regulations. Questions have arisen recently, however, concerning whether too many permits have been issued, a common occurrence in cap-and-trade programs.

This was the first cap-and-trade program in the United States to employ public sales of emissions allowances (run by the Chicago Board of Trade) in addition to allowing private sales. Anyone can purchase these permits. Tom Tietenberg, an economics professor who has long been concerned with environmental issues, reports that many of his students have purchased allowances as Christmas or birthday gifts. Such purchases, by removing permits from utilities, may further reduce total emissions in a given year. The acid rain program clearly has been the most important, sophisticated, and successful cap-and-trade program in the United States. But it is small potatoes compared to what would be required under a cap-and-trade limit for greenhouse gases.

Nonetheless, regions and governments have begun to experiment with the market-based regulatory model to take on this much larger task. In 2008, for example, ten northeastern and mid-Atlantic states joined together in the Regional Greenhouse Gas Initiative to create a cap-and-trade mechanism to restrict carbon emissions by electric utilities. These ten states have capped carbon dioxide emissions from power plants at levels designed to reduce emissions by 10 percent over the following decade. They also allow buying and selling of permits among electric utilities in any of the member states; an electric utility can use carbon dioxide allowances issued by any of the member states to comply with its state's requirements. Each state auctions nearly all of the Regional Greenhouse Gas Initiative's allowances quarterly. By the end of 2009, more than 170 million allowances (each permitting one ton of carbon dioxide emissions) had been auctioned at prices ranging from $1.86 to $3.51 per allowance, yielding nearly $500 million in revenues for the member states. Similar alliances are being launched in the West (the Western Climate Initiative, involving half a dozen states and four Canadian provinces) and the Midwest (the Midwestern Greenhouse Gas Accord, involving six states)

To date, however, the most extensive effort to contain greenhouse gasses with a market system has occurred in the European Union (EU). The EU's

emissions-trading scheme was created to address Europe's obligations to reduce greenhouse gas emissions pursuant to the Kyoto Protocol to the United Nations Framework Convention on Climate Change. As I have described, the United States is a signatory to the Framework Convention and signed but did not ratify the Kyoto Protocol, which was agreed to by 190 countries, including all EU member states. The Kyoto Protocol set binding emissions targets for 37 developed countries for carbon dioxide and five other greenhouse gases, including methane, nitrous oxide, and hydroflourocarbons. Under the protocol, specified targets must be reached between 2008 and 2012.

In its first phase, which ended in 2007, the EU cap-and-trade system covered carbon dioxide emissions from about 12,000 firms in the electric power sector and certain energy-intensive manufacturing industries in 25 countries. These firms together account for about half of total EU emissions. In 2005, this program produced a $12.4 billion market in EU allowances sold through several markets, including three exchanges in the United States, and by 2007 the World Bank estimated the total value of EU allowances to be about $50 billion. The allowances—each of which permits the emission of one metric ton of carbon dioxide—were initially allocated to industries and firms by each member state, but they can be traded to any company in the EU.

This phase of the EU system encountered substantial difficulties. The member states allocated total allowances in excess of the actual emissions then occurring. This excess of course resulted in uncertain and minimal effects on total emissions and very little positive impact on technology innovation and development. In fact, the Environmental Audit Committee of the British Parliament concluded that the level of Europe-wide emissions actually increased by 38 million tons between 2005 and 2007. In addition, there was significant volatility in the prices of permits, with allowances selling for €10.40 per ton in 2005, €37.48 in April of 2006, and zero in 2007.

Phase II of the program began in 2008, and the European market was estimated in 2010 to total about €130 billion (which would expand to an estimated worldwide $3 trillion market in 2020 if Japan and the United States also were to participate). Price volatility remained an issue, with allowance prices ranging from nearly €30 a ton to less than €10 in 2008 and 2009. In January 2010, using a computer fraud technique known as

"phishing," thieves obtained access codes from companies and traders to obtain permits, which they then sold, netting at least $4 million. The biggest concern, however, according to Larry Lohmann of Corner House, a British environmental advocacy group, "is measuring whether the so-called reductions in emissions that are claimed by participants in these markets actually happen at all." If not, that would "turn out to be the far bigger fraud."

In 2010, the British Parliament's Environmental Audit Committee raised serious concerns about the effectiveness of the EU's cap-and-trade system for the future. Tim Yeo, the committee's chairman, said, "Emissions trading should be helping us to combat climate change, but at the moment the price of carbon simply isn't high enough to make it work." He added, "If the government wants to kick-start serious green investment, it must step in to stop the price of carbon [from] flatlining." He also suggested that Parliament "seriously explore the possibility of a carbon tax." Sarah-Jayne Clifton of Friends of the Earth said, "Not only is trading failing to drive down emissions, banks are growing fat developing ever more complex trading systems and this risks another financial crash."

Adopting a greenhouse gas cap-and-trade system in the United States requires Congress (or the EPA) to resolve a number of inevitably controversial issues. As Europe's experience has shown, the details will be critically important in determining the extent to which environmental goals are met, the effects on the economy, and the distribution of benefits and burdens. Hundreds of learned articles and many books have been written analyzing the pros and cons of the various decisions that must be made, and I do not intend to plumb all their depths here. It is nevertheless instructive to examine briefly some of the more important issues.

First, the government must decide which pollutants will be capped at what levels over what time period and for which emitters. It must also decide how allowances will be initially distributed and whether one year's allowances will be permitted to be "banked" and used in a subsequent year or "borrowed" to be used in an earlier year. It must also establish rules and regulatory structures governing the buying and selling of allowances, including whether to restrict potential increases or decreases in allowance prices. Furthermore, it must determine to what extent and under what circumstances to allow "offsets"—the ability to pay someone else for lowering emissions, such as by revising agricultural practices or foregoing deforestation. Finally, because the problem of global warming is global, we must determine how to coordinate our efforts with those of other nations around the world. None of these issues is easy.

Let's begin with the difficulty of setting the cap. The main reason environmentalists prefer cap and trade to a carbon tax as the principal method to address the risks of climate change is that the latter focuses on increasing the price of carbon emissions, whereas the former directly limits the quantity of emissions. But setting the emissions caps and how they will be phased in is hardly a simple or straightforward exercise. Uncertainty abounds.

The IPCC has estimated that by the end of this century, without major policy changes, ongoing emissions of greenhouse gases will likely double the concentration of greenhouse gases in the atmosphere relative to their preindustrial level of 280 ppm. Concentrations currently are about 385 ppm and are growing by about 2 ppm a year. Many scientists believe that levels of 450 ppm are dangerous; some, including James Hansen, believe that the IPCC estimates are too optimistic and that we need to lower levels to 350 ppm. Very few scientists regard levels higher than 550 ppm as safe. Summarizing 22 scientific studies, the IPCC in 2007 estimated that doubling preindustrial levels would produce an increase in global mean temperatures "most likely" ranging from 1°C (1.8°F) to 4.5°C with an expected value of 2.5 to 3.0°C. The IPCC suggests that this range reflects a 60 to 90 percent confidence level, but that the probability of a temperature increase higher than 4.5°C is between 5 and 17 percent. These IPCC estimates thus imply that there is a 5 percent probability that conducting business as usual would lead to an increase in global mean temperature of 7°C or more and a one percent probability that it would produce a 10°C temperature increase.

The less likely but more dangerous estimates of temperature increases might be catastrophic worldwide. In addressing a United Nations meeting on climate change in 2009, Barack Obama called on nations to act now to reduce the prospect of a worldwide "irreversible catastrophe." It is, of course, the prospect of genuine disaster that grabs the public's attention and has galvanized the world's and our nation's political leaders into action. As Nicholas Stern has put it, "The issue for policy is how to manage risk, taking account of strong scientific evidence that the risks are potentially very large."

But not only are estimates of the magnitude and scope of the risks of climate change from greenhouse gas emissions controversial among scientists; these estimates will change over time as new facts and new scientific studies emerge. Temperature changes are not the only uncertainty; also uncertain are the potential effects of temperature increases on economies and ecosystems around the world. The likely effects will vary greatly by regions. If the IPCC's most probable estimates prove true, Canada and our northern states will mainly enjoy warmer winters, but low-lying islands may disappear entirely. In October 2009, Douglas Elmendorf, director of the Congressional Budget Office (CBO), told the Senate that with warming of about 4°C (7°F), a "relatively pessimistic estimate," is that the U.S. GDP would decline by about 3 percent. He added: "There is such great uncertainty about how a given quantity of emissions would ultimately affect global temperature that there is very little additional certainty to be gained from choosing a fixed emissions goal . . . rather than a price path." Elmdendorf's essential point was that there is little, if any, reason to prefer cap and trade's focus on quantities over a carbon tax's focus on prices. Experience so far in Europe's and our states' regional cap-and-trade efforts supports his view.

Having overlearned the lessons of Jimmy Carter's political problems from calling on Americans to sacrifice, our politicians now insist that any sacrifices by the public resulting from a dramatic transformation of our nation's energy production and consumption must be minimal. The politicians' unwillingness to confront the potential costs straightforwardly necessarily limits the potential range of legislative answers to the central questions that our democratic process must ultimately answer: How much change will be required and over what time period? In Congress, this question becomes transformed from a scientific to a political inquiry. In 2009, President Obama and Democratic congressional leaders essentially agreed that our nation's emissions of greenhouse gases should be reduced by 3 percent from their 2005 levels by 2012 (the nearest presidential election year), by about 17 to 20 percent by 2020, and by more than 80 percent by 2050.

These goals generally reflect the consensus among environmental advocacy groups that we should endeavor to limit worldwide greenhouse gas concentrations in the atmosphere to less than 450 ppm and worldwide temperature increases to 2°C (3.6°F). But the goals were also set to keep

low the short-term costs to the public. This slow phase in of emissions reductions has provoked criticisms from some environmentalists, who believe that by going so slowly the United States is foregoing an opportunity for global leadership. In contrast, many economists and virtually all Republican politicians argue that abatement of carbon dioxide emissions should begin slowly or even be delayed while over the next decade or two we learn more about the sensitivity of the climate to greenhouse gases and about the potential human, ecological, and economic impacts of climate change and so we can see how technology advances can lower the costs of reducing the level of our greenhouse gas emissions. This split, of course, will affect the political compromises of any energy legislation.

Another key decision policymakers must make is which polluters shall be subject to regulation. Because greenhouse gases escape from virtually every automobile, every building, every manufacturing facility, every farm, and most electric utilities, the potential difficulties of monitoring emissions and enforcing limitations are daunting. Such monitoring and enforcement would be a far more difficult problem than enforcing the cap-and-trade program for constantly computer-monitored sulfur dioxide emissions from U.S. power plants.

Carbon dioxide is the greenhouse gas emitted in the greatest quantities, and about 80 percent of all greenhouse gas emissions occur from the combustion of fossil fuels (the bulk of the rest comes from some industrial gases, agriculture, and deforestation). Cap-and-trade legislation in both the United States and Europe has focused initially on utilities that generate electricity and on importers and refiners of petroleum or other fossil fuels. Industrial sources that annually emit more than a specific threshold of carbon dioxide, such as 25,000 metric tons, should also be covered, along with natural-gas local distribution companies. All in all, in such a regime about 7,400 facilities would be subject to limitations that would have to be monitored by the EPA, and at least 60 percent of greenhouse gas emissions should be covered. (A separate cap-and-trade regime would apply to hydroflourocarbons.)

Once the class of businesses to be regulated is decided, there are questions of how to design the market these firms will be required to participate in. One key aspect of any cap-and-trade legislation is whether firms subject to emissions caps would be permitted to purchase "offset credits" to reduce their costs further. Most cap-and-trade legislation allows such offsets

despite ongoing questions about whether they will be genuinely additional, permanent, and real. For example, utilities might pay landowners for such offset credits if what they plant absorbs carbon dioxide from the atmosphere or if they forego deforestation. Carbon sequestration and various alternative energy projects may also qualify for offsets. Cap-and-trade proposals generally would allow from one-third to two-thirds of emission-reduction requirements—up to 2 billion tons of greenhouse gases annually—to be satisfied by purchasing offsets. As much as one-half or two-thirds of those offsets might be purchased abroad. As the Congressional Research Service has said, there are "almost an infinite number of possible scenarios for offsets."

Because reducing emissions through offsets may be much cheaper than the transformations required by utilities and industries directly subject to the caps, the potential cost savings from allowing offsets are large. There is widespread agreement that offsets may reduce allowance prices by at least half. The CBO has estimated that the use of offsets might reduce allowance prices by about 70 percent and that even more liberal use of offsets would generate even greater cost savings. It is also worth bearing in mind that as emissions caps tighten and the price of allowances increases over time, the advantages of purchasing offset credits will also grow.

The theory behind offsets is that they will encourage firms that are not subject to the emissions caps to participate in reducing emissions—and to profit from doing so—whenever it is cheaper for them to reduce emissions. Because climate change is a global phenomenon and reducing emissions abroad may often be considerably cheaper than in the United States, it also makes sense—in principle at least—to allow firms to purchase such offset credits anywhere in the world. By buying them, however, firms subject to emissions limitations will be allowed to exceed their caps. And whenever offsets are purchased internationally in lieu of reducing emissions domestically, the United States will exceed its stated goals for emissions reductions (which has happened in Europe under the Kyoto Protocol). By making the United States seem to be behaving much worse than it actually is, offsets may diminish U.S. credibility in international negotiations, and we might forfeit any claim to global leadership that we wish to assert. More important, ensuring that such offsets are real, permanent, verifiable, enforceable, and additional (i.e., they would not have occurred in any event) will be no easy task.

The Kyoto Protocol established such an offset credit program, known as the Clean Development Mechanism, which allows companies in the 37 countries subject to binding emissions caps to purchase offset credits for emissions reduction projects in developing countries. This experiment has been subjected to fierce criticism on the grounds that approval of projects is slow, costly, and cumbersome. More important is the concern that actual reductions of emissions beyond what would have occurred anyway are questionable and perhaps temporary.

There has also been considerable concern, albeit not from the financial sector, about the likely volatility of prices for emissions allowances (and for offset credits if they become tradable). Volatility in permit prices complicates utilities' ability to evaluate long-term investment prospects. Cap-and-trade legislation may employ a variety of techniques intended to reduce potential fluctuations in prices. One way to decrease such volatility is to permit owners of emissions allowances for one year to "bank" them to be used in future years. Because the effects on climate change from greenhouse gas emissions depend on their aggregate levels, not on the annual flow, this approach seems appropriate. "Borrowing" allowances from future years to be used earlier is also possible, but it creates concerns that it may cause pressure on the political willingness to maintain stringent limits on emissions in the future. The government may also hold back some allowances to be sold on the open market if and when the prices of emissions allowances seem high enough to raise concerns for the health of the U.S. economy. One variation sometimes suggested is to permit the president to impose price ceilings or a price collar (a floor and a ceiling on prices) whenever he or she deems the price increases or decreases or the volatility of allowances to be excessive. A cap-and-trade system with a price floor and a ceiling to limit the range of prices would provide increased price certainty to investors and, if allowances were auctioned, would move closer to a carbon tax in its overall economic effects.

Such a market in the United States will likely involve hundreds of billions of dollars of transactions annually and will inspire all sorts of derivative contracts similar to those now present in other commodity markets. The market for emissions permits will presumably be subject to regulatory oversight similar to that of other commodity or derivative markets. In recent years, however, such oversight has left much to be desired. New

financial regulations have been enacted, and their effectiveness will impact the integrity of any cap-and-trade program.

If properly designed and regulated, cap-and-trade legislation, like a carbon tax, should raise the prices of carbon-based fuels. For this reason, it becomes important to protect from excessive burdens low- and moderate-income families who spend a disproportionate share of their income on energy consumption. There are a number of ways to accomplish this protection—for example, by providing increased cash benefits to current recipients of food stamps, unemployment or disability insurance, or Social Security or by expanding earned-income tax credits. Any or all of these mechanisms are preferable to endeavoring to minimize price increases for electricity or petroleum products because the latter would undermine the price effects that a cap-and-trade system is intended to effectuate. It will be necessary, however, to monitor price increases and such benefits on an ongoing basis to make sure that low-income families are protected over time.

In order to understand the full implications of enacting a cap-and-trade system for greenhouse gases, one must also take into account our federalist system. Any national legislation might preempt state or regional cap-and-trade programs but would permit other forms of state, regional, or local regulations—for example, California auto emissions regulations and energy-efficiency requirements—to coexist alongside federal laws. States might also enact their own carbon taxes, technology or renewable energy standards, or emissions limits that are more stringent than the federal cap for any particular year. If they did so, they might induce price changes in the national market for emission permits. If that happens to any widespread extent, businesses may petition the federal government to halt the state actions.

For all the enormous changes that cap and trade would bring to the regulation of carbon emissions, Congress and the states will not entirely abandon the older form of command-and-control regulations. Indeed, any cap-and-trade or other energy legislation will also contain a long list of energy-efficiency mandates affecting commercial and industrial buildings, a host of appliances, and other electric products in an effort to induce greater efficiency in U.S electricity consumption. Expanding on an idea from legislation of the 1970s, there may also be requirements that electric utilities obtain a specific portion—perhaps as much as 20 to 30 percent—of their total power output from specified renewable sources. (It would also

be possible to allow "trading" among utilities of renewable energy requirements, much as the EPA did with Clean Air Act requirements in the mid-1970s.)

Because climate change is a global problem attributable to greenhouse gas emissions regardless of source, any effective response must reduce emissions worldwide over time. Improvement in everyone's climate prospects turns on efforts made throughout the world. International coordination and cooperation is essential, if difficult. Some have suggested that one of the advantages of cap and trade over carbon taxes is that the former makes reaching international agreements easier. As an MIT assessment of U.S. cap-and-trade proposals put it, "A major strategic consideration in setting U.S. policy targets should be their value in leading other major countries to take on similar efforts."

Because of U.S. cap-and-trade legislation's slow phase-ins of emissions reductions, we will not know of its success or failure for quite a long time. As Lincoln Moses, the first administrator of the Energy Information Administration, once said, "There are no facts about the future." Given, as we shall see in the next chapter, the enormous political and corporate forces acting to shape legislation in Congress, however, it is difficult to believe that cap and trade will actually achieve the emissions-reductions goals established by President Obama and Congress. Here's how a former Democratic congressional leader privately explained the political popularity of cap and trade: "No one really understands it." But in the wake of the recent financial crisis, opaque markets may have lost some of their appeal.

NASA's James Hansen views cap and trade as "essentially a sham," calling it the "Temple of Doom." He has urged instead a worldwide moratorium on new coal-fired electricity plants and a phaseout of all existing coal plants over the next two decades. We better hope that Hansen—who was apparently right about climate change in the 1970s, 1980s, and 1990s—is wrong this time; his suggestions are gaining little traction. Even with our discovery of ways to obtain large domestic sources of natural gas, coal-fired electricity is not about to disappear anytime soon.

Taxing carbon and returning the proceeds to the public would be more straightforward, more predictable, administratively easier, and perhaps even more effective than cap-and-trade legislation. Some EU member states are tellingly considering enacting carbon taxes as a backstop to its cap-and-trade program. Indeed, Ireland in 2010 enacted a carbon tax on petroleum

products, coal, and natural gas. As in the United States, however, political barriers to a Europe-wide carbon tax loom large.

It is to those political barriers here at home that we now turn. A gradual but quickly tightening cap-and-trade system as the preferred method for the government regulation of energy may make sense to environmentalists, some academic economists, and certain believers in markets. It may even make sense in practice if designed and implemented in a world of rational policymaking. Alas, that is not the world we live in. We live in a world where any major reform affecting significant economic interests—whether they be based on profits in health care, finance, or energy—is subject to a legislative process so deeply influenced by the very industries that such reforms aim to control that the results can end up seeming more like a mockery of the original idea than a solution to the problem. The greatest barrier to making a cap-and-trade system work may not be the concepts, but the sclerotic system though which it must be enacted.

13 Government for the People? Congress and the Road to Reform

In 2009 and 2010, the most significant energy legislation in a generation was being debated in Congress. Hundreds if not thousands of interest groups from business, the environmental movement, organized labor, and citizen action committees, together with all their lobbyists, jammed the halls of the Capitol to press their case for myriad different policies and provisions or simply for their share of the pork. Think tanks and academics and the talking heads who spin their work into sound bites geared up for what advocates anticipated might be a landmark bill reshaping energy policy for decades to come. In 2009, the House passed its bill, which included a cap-and-trade system for carbon dioxide along with other regulatory mandates and subsidies. By the end of summer 2010, however, the Senate had all but given up. Cap and trade still seemed to hold center stage, but several alternatives were vying to garner the necessary support. Opponents of climate change legislation now had the upper hand. The battle echoed the 1970s' struggle over energy legislation, especially the pricing of natural gas, but the stakes this time were much higher: imposing a price on carbon emissions would affect all of our fossil fuels and the products they produce. In November 2010, voters swept the House Democratic majority out of office and in the process took comprehensive climate change legislation off the table—at least for a while. But, despite cratering in 2010, energy does not seem likely to disappear from Congress's agenda anytime soon.

The big question is, how effective will any energy legislation be? Or, in other words, will cap-and-trade bills of the sort that have traveled under the short hand of the Waxman–Markey bill in the House and its variations in the Senate—or any major new energy legislation—forge a

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Chapter 11

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On the EPA's successful use of a tradable credits approach to phase out leaded gasoline, see Tietenberg, "Tradable Permit Approaches to Pollution Control," available at http://www2.ing.puc.cl/seminario/Documentos/TradablePermitsApproaches Tietenberg.pdf; and Stavins, "Experience with Market-Based Environmental Policy Instruments," 395–396. On the agency's allocation of tradable permits to eliminate ozone-depleting chemicals and on the excise tax that soon followed to mitigate windfall profits, see these same two articles: Tietenberg, 5, and Stavins, 400–401. Stavins concludes that the subsequent tax was more effective than the tradable permits.

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For more on the "important" role that allocation auctions can play in a cap-and-trade system and "how auctions have been used in some existing efficient greenhouse gas cap-and-trade programs in the United States and abroad," see Alan Krueger, Assistant Secretary for Economic Policy Designate and Chief Economist, U.S. Department of the Treasury, statement to the Finance Committee, U.S. Senate, 111th Cong., 1st sess., May 7, 2009, http://finance.senate.gov/hearings/hearing/?id=d8bf9810-9806-b79e-9989-5473d579d9fb. See also Anne E. Smith, Ph.D., prepared statement, *Auctioning under Cap and Trade*, hearing, 111th Cong., 1st sess., May 7, 2009, http://finance.senate.gov/hearings/hearing/?id=d8bf9810-9806-b79e-9989-5473d579d9fb, which discusses practical differences between auctions and free allocations in regard to "the distribution of carbon value that can be accomplished"; Delbeke, written statement, *Auctioning under Cap and Trade*, hearing, May 7, 2009, 111th Cong., 1st sess., which describes how allocating free emissions allowances would likely lead to windfall profits for regulated companies, at the expense of the public budget; and Alan D. Viard, testimony, *Climate Change Legislation: Allowance and Revenue Distribution: Hearing before the Committee on Finance, U.S. Senate*, 111th Cong., 1st sess., August 4, 2009, http://finance.senate.gov/hearings/hearing/?id=1f3ebe07-009e-744b-93a4-67168d05fc4b, which argues that free allocations of emissions allowances harm economic efficiency and produce negative distributional concerns, both of which can be avoided through an auction system.

For an argument that the choice between auctions and free allocations is "less important than it seems" and "doesn't affect the environmental efficacy or cost-effectiveness of the program," see Nathaniel O. Keohane, Ph.D., Director of Economic Policy and Analysis, Environmental Defense Fund, testimony before the Committee on Finance, U.S. Senate, 111th Cong., 1st sess., August 4, 2009, http://www.edf.org/documents/10295_Testimony_Keohane_Senate_080409.pdf.

For IPCC estimates about the likely trajectory of climate change during this century, see Intergovernmental Panel on Climate Change, *Climate Change 2007: The Physical Science Basis* (Cambridge, UK: Cambridge University Press, 2007); Intergovernmental Panel on Climate Change, *Climate Change 2007: Impacts, Adaptation, and*

Vulnerability (Cambridge, UK: Cambridge University Press, 2008); and Intergovernmental Panel on Climate Change, *Climate Change 2007: Mitigation of Climate Change* (Cambridge, UK: Cambridge University Press, 2007). The IPCC's estimates regarding the probable rise in global temperatures are discussed in Martin L. Weitzman, "Some Dynamic Economic Consequences of the Climate Sensitivity Inference Dilemma," unpublished paper, February 2008; the controversy surrounding the IPCC's work is discussed in chapter 10. There have been many ongoing reviews and analyses. For one that regards the IPCC temperature estimates as overly optimistic, see United Nations Environment Program (UNEP), *Climate Change Science Compendium* (Paris: UNEP, 2009), http://unep.org/COMPENDIUM2009.

For Hansen's opinions about cap and trade, see James E. Hansen, "Worshipping the Temple of Doom," letter to the Australian government, preceded by a two-page commentary, May 5, 2009, http://www.columbia.edu/~jeh1/mailings/2009/20090505_TempleOfDoom.pdf. See also Elizabeth Kolbert, "The Catastrophist," *The New Yorker* (June 29, 2009), 39; Bill McKibben, *Eaarth: Making Life on a Tough New Planet* (New York: Times Books, 2010), chaps. 1, 3, and 4.

For President Obama's United Nations speech on climate change, see "Remarks by the President at United Nations Secretary General Ban Ki-Moon's Climate Change Summit," speech at United Nations Headquarters, New York, September 22, 2009, http://www.whitehouse.gov/the_press_office/Remarks-by-the-President-at-UN-Secretary-General-Ban-Ki-moons-Climate-Change-Summit. The quote from Nicholas Stern is from "Climate: What You Need to Know," *New York Review of Books*, June 24, 2010, 37. CBO director Elmendorf's observations on climate change and its likely effects are from Douglas W. Elmendorf, Director, CBO, statement to the Committee on Energy and Natural Resources, U.S. Senate, 111th Cong., 1st sess., October 14, 2009, http://www.cbo.gov/ftpdocs/105xx/doc10561/10-14-Greenhouse-GasEmissions.pdf. The estimate of a 3 percent decline in GDP is on page 3; the "price path" quote is on page 6.

There is enormous debate in the climate change literature about how much of a change in emissions will be required and over what time period. Compare, for example, Nicholas Stern, *The Economics of Climate Change: The Stern Review* (Cambridge, UK: Cambridge University Press, 2007), with William D. Nordhaus, *A Question of Balance: Weighing the Options on Global Warming Policies* (New Haven, CT: Yale University Press, 2008). See also Robert S. Pindyck, *Uncertain Outcomes and Climate Change Policy*, Working Paper 4742-09 (Cambridge, MA: MIT Sloan School, August 6, 2009), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1448683.

The basic agreement between President Obama and Democratic congressional leaders on the appropriate rate of progress in combating climate change is reflected in H.R. 2454, known as the Waxman–Markey bill and the American Clean Energy and Security Act of 2009. The Senate failed to enact such legislation before the 111th Congress expired. For a detailed guide to the bill's key provisions and the current regulatory context, see Davis Polk and Wardwell, LLP, "U.S. House of Representatives Approves Landmark Climate Change Legislation," client memorandum, July 16, 2009, http://www.davispolk.com/files/Publication/f78abb11-af6f-4ade-a4bb-0462a1a49cb5/Presentation/PublicationAttachment/0d25f563-1698-4e74-b731-0d6a9ff52652/071609_Climate_Bill.pdf. Analysis of the bill's features, including discussion of the president's goals, can also be found in Larry Parker and Brent D. Yacobucci, Congressional Research Service, *Climate Change: Costs and Benefits of the Cap-and-Trade Provisions of H.R. 2454*, R40809 (Washington, DC: Congressional Research Service, September 14, 2009); Jonathan L. Ramseur, Larry Parker, and Brent D. Yacobucci, Congressional Research Service, *Market-Based Greenhouse Gas Control: Selected Proposals in the 111th Congress*, R40556 (Washington, DC: Congressional Research Service, May 20, 2009), 1–2; and Congressional Budget Office, *Cost Estimate: H.R. 2454, American Clean Energy and Security Act of 2009* (Washington, DC: Congressional Budget Office, June 5, 2009), 5.

Writing in *The New Yorker* in late 2009, Elizabeth Kolbert complained that U.S. commitments to reducing greenhouse gas emissions were lower than those of either Japan or Europe, adding that Japan and Europe are using 1990, not 2005, as a baseline. See Elizabeth Kolbert, "Leading Causes," *The New Yorker* (October 5, 2009), http://www.newyorker.com/talk/comment/2009/10/05/091005taco_talk_kolbert. For an example of an economist who argues that emissions reductions should be implemented slowly, see Pindyck, *Uncertain Outcomes and Climate Change Policy*.

On the role of offsets in a cap-and-trade system, see Congressional Budget Office, *The Use of Offsets to Reduce Greenhouse Gases* (Washington, DC: Congressional Budget Office, August 3, 2009), http://www.cbo.gov/ftpdocs/104xx/doc10497/08-03-Offsets.pdf; and U.S. Government Accountability Office, *Carbon Offsets: The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants*, GAO-08–1048 (Washington, DC: U.S. Government Accountability Office, August 2008), http://www.gao.gov/new.items/d081048.pdf, which discusses the difficulties of predicting what emissions reductions would have occurred in the absence of an offset payment. Jason Scott Johnston, "Problems of Equity and Efficiency in the Design of International Greenhouse Gas Cap-and-Trade Schemes," *Harvard Environmental Law Review* 33 (2009): 405–430, argues that emissions reductions in an international system utilizing offsets may be undermined by problems of enforceability and verifiability. For an argument that the United States should rely on more explicit cost-control mechanisms instead of on offsets, see Michael W. Wara and David G. Victor, *A Realistic Policy on International Carbon Offsets*, Working Paper no. 74 (Stanford, CA: Program on Energy and Sustainable Development, April 18, 2008), http://iis-db.stanford.edu/pubs/22157/WP74_final_final.pdf.

For the Congressional Research Service quote on "infinite" scenarios for offsets, see Parker and Yacobucci, *Climate Change*, 18. The CBO's estimate on the degree to which the use of offsets would lower emissions allowance prices is found in Congressional Budget Office, *Cost Estimate*, 18. A consensus is that offsets will reduce costs by more than half (see Parker and Yacobucci, *Climate Change*, 47).

For a description of the Clean Development Mechanism under the Kyoto Protocol, see Kyle W. Danish, "The International Regime," in *Global Climate Change and U.S. Law*, ed. Gerrard, 46–51. For criticisms of the offset credit program under Kyoto and similar European initiatives, see, for example, Madhusree Mukerjee, "Is a Popular Carbon-Offset Method Just a Lot of Hot Air?" *Scientific American* (June 2009), http://www.scientificamerican.com/article.cfm?id=a-mechanism-of-hot-air; and Lambert Schneider, *Is the CDM Fulfilling Its Environmental and Sustainable Development Objectives? An Evaluation of the CDM and Options for Improvement* (Freiburg, Germany: Öko-Institut, prepared for the World Wildlife Fund, November 5, 2007), http://www.oeko.de/oekodoc/622/2007-162-en.pdf. Current proposals for U.S. cap-and-trade legislation contemplate a robust ability of firms subject to emissions caps to purchase both domestic and international offset credits. International projects in developing countries would qualify only if the country has an agreement with the United States. On "banking" and "borrowing" as mechanisms to mitigate price volatility, see Parker and Yacobucci, *Climate Change*, 7, 23; and Durning et al., *Cap and Trade 101*, 17. The use of a price ceiling or collar to stability volatility is discussed in Warwick J. McKibbin, Adele Morris, Peter J. Wilcoxen, and Yiyong Cai, *Consequences*

of Alternative U.S. Cap-and-Trade Policies: Controlling Both Emissions and Costs (Washington, DC: Brookings Institution, July 24, 2009), 11–14.

For a discussion of how low-income households may be affected by the allocation of greenhouse gas emissions allowances and the need for well-designed policies that address this concern, see Chad Stone, Chief Economist, Center on Budget and Policy Priorities, testimony before the Committee on Energy and Natural Resources, U.S. Senate, 111th Cong., 1st sess., October 21, 2009, http://www.cbpp.org/files/10-21-09climate-testimony.pdf. See also Andrew Chamberlain, *Who Pays for Climate Policy? New Estimates of the Household Burden and Economic Impact of a U.S. Cap-and-Trade System*, Working Paper no. 6 (Washington, DC: Tax Foundation, March 16, 2009), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1361257.

Federalism and the role of the states in climate change policy is discussed in Daniel A. Farber, *Climate Adaptation and Federalism: Mapping the Issues*, Public Law Research Paper no. 1468621 (Berkeley: University of California, September 9, 2009), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1468621. Lesley K. McAllister, "Regional Climate Regulation: From State Competition to State Collaboration," *San Diego Journal of Climate and Energy Law* 1 (2009): 81–102, examines collaborative initiatives among states and how they have been prompted in part by federal inaction. Ann E. Carlson, "Iterative Federalism and Climate Change," *Northwestern University Law Review* 103 (2009): 1097–1162, examines significant state efforts on global warming and how they spring from and interact with federal law.

The MIT quote on designing U.S. policy targets with the goal of influencing other nations is found in Sergey Paltsev, John M. Reilly, Henry D. Jacoby, Angelo C. Gurgel, Gilbert E. Metcalf, Andrei P. Sokolov, and Jennifer F. Holak, *Assessment of U.S. Cap-and-Trade Proposals*, Joint Program on the Science and Policy of Global Change Report no. 146 (Cambridge, MA: MIT, April 2007), 55. Lincoln Moses is quoted in Parker and Yacobucci, *Climate Change*, i. Ireland's new carbon tax was introduced in Finance Bill 2010 (Act no. 9/2010), http://www.finance.gov.ie/documents/publications/Finance%20Bill%202010/Bill2010.pdf.

Chapter 13

On the vast number of interest groups lobbying Congress on climate change, see Marianne Lavelle, "Tally of Interests on Climate Bill Tops a Thousand," Center for Public Integrity, August 10, 2009, http://www.publicintegrity.org/articles/entry/1609. Similar lobbying efforts over energy legislation during the late 1970s are reported in Charles Mohr, "Business Using Grass-Roots Lobby," *New York Times*, April 17, 1978, A1; Charles Mohr, "Opposing Sides Agree on Ways to Shift to Coal," *New York Times*, February 10, 1978, A1; Steven V. Roberts, "Activists Prod Senators on Energy, *New York Times*, October 1, 1977, 25; and John R. Emshwiller, "Shareholders United to Help Utility Firms Battle Regulators and Consumer Groups," *Wall Street Journal*, April 13, 1978, 46. The House climate bill, known as Waxman–Markey, is the American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong., 1st sess., 2009. It was passed on June 26, 2009, and was received in the Senate on July 6.

For a comparative analysis of how different political systems vary in the extent to which they grant veto power to political actors and the ramifications of these differences, see George Tsebelis, *Veto Players: How Political Institutions Work* (Princeton, NJ: Princeton University Press, 2002). For David Wessel's comments, see David Wessel, "The Californization of Washington," *Wall Street Journal*, March 4, 2010, http://online.wsj.com/article/NA_WSJ_PUB:SB10001424052748704541304575099371249822654.html. Richard Lazarus comprehensively reviews the history of environmental law in *The Making of Environmental Law* (Chicago: University of Chicago Press, 2004). The statements quoted are from his article "Congressional Descent: The Demise of Deliberative Democracy in Environmental Law," *Georgetown Law Journal* 94 (2006), 620–622. For Mann and Ornstein's observations on Congress, see Thomas E. Mann and Norman J. Ornstein, *The Broken Branch: How Congress Is Failing America and How to Get It Back on Track* (New York: Oxford University Press, 2006), 242. For a discussion of how economic conditions in the 1960s and early 1970s encouraged Americans to take economic abundance for granted, contributing to "an upsurge of citizen activism" and faith in the government's ability to manage economic problems, see David Vogel, *Fluctuating Fortunes: The Political Power of Business in America* (New York: Basic Books, 1989), 96–97.

On Congress's assertion of its power vis-à-vis the president during the early 1970s, see Mann and Ornstein, *The Broken Branch*, 59–60. The two statutes discussed are the *War Powers Resolution*, Public Law 93-148, 87 Stat. 555 (1973), and *Impoundment Control Act of 1974*, Public Law 93-344, title X, 88 Stat. 297 (1974). Richard E. Cohen, *Washington at Work: Back Rooms and Clean Air*, 2d ed. (New York: Longman, 2009), 12–23, examines the disproportionate influence exerted by a few senators on the Clean Air Act and other contemporary legislation. Lazarus, "Congressional Descent," discusses changes in the House (665–666), the "demise of bipartisanship" (668–677), and the pattern of partisan voting in the early 1970s and mid-1990s (670). The great influence of a small number of committee chairs during this period and the breakdown of this power structure following the elections of 1974 is explored n Mann and Ornstein, *The Broken Branch*, 51, 52–53, 61–63. Tommy Boggs is quoted in Vogel, *Fluctuating Fortunes*, 206 (which cites Philip Shabecoff, "Big Business on the Offensive," *New York Times Magazine*, December 9, 1979, 91).

For John Dingell's background and constituency, see Cohen, *Washington at Work*, 29–33. In 1981, Congressman Dingell married Deborah Insley, a General Motors executive whose family roots go back to the Fisher Body Corporation, which was acquired by General Motors in 1919. Washington insiders, however, insist that John Dingell, whose district was once the home to 80,000 auto industry jobs, was "married to General Motors long before he was married" to Deborah Insley (Cohen, *Washington at Work*, 29). Cohen's book also covers Henry Waxman's background (31) as well as Dingell's record defending the auto industry and its workers and Waxman's victory over him in the 1977 Clean Air Act amendments (31–44). The story of how Waxman later wrested Dingell's committee chairmanship from him is told in John M. Broder and Carl Hulse, "Behind House Struggle, Long and Tangled Roots," *New York Times*, November 23, 2008, A26 (including President Obama's and House Speaker Pelosi's tacit support for Waxman); Naftali Bendavid and Stephen Power, "Waxman Takes Over Energy Panel," *Wall Street Journal*, November 21, 2008, A6; and Janet Hook and Richard Simon, "Waxman Gets Key Energy Position," *Los Angeles Times*, November 21, 2008, A1. In February 2009, Dingell became the longest-serving member in the history of the House of Representatives and with the death of Senator Robert Byrd in June 2010 the senior member of Congress (see Bendavid and Power, "Waxman Takes Over Energy Panel").

For a sample of empirical research that attempts to elucidate the roles of ideology, political party, regionalism, and constituent interests in decision making by representatives, see Charles R. Shipen and William R. Lowry, "Environmental Policy Party Divergences in Congress," *Political Research Quarterly* 54 (2001): 245–263; Steven D. Levitt, "How Do Senators Vote? Disentangling the Role of Voter Preferences, Party Affiliation, and Senator Ideology," *American Economic Review* 86 (1996): 425–441;