CHAPTER 6

Policy for Whom?

This study shows that a carbon-free opportunity exists to meet the challenge of reducing U.S. carbon emissions by 2030 while being cost competitive with today's energy costs. Some renewable options can generate wholesale electricity at 4 to 10 cents/kW·h, whereas others cost less than retail electricity cost for on-site systems in certain regions. Energy efficiency options are less than $2.30 to $5/MBtu natural gas (today's price is about $10/MBtu), less than $29/bbl oil (today's price is 50 to 150 $/bbl), or less than 4 cents/kW·h (today's price is closer to 10 cents/kW·h). The historical cost reductions of renewable options were considered to continue and future costs of conventional fuels and electricity were considered to increase but at a rate based on the very conservative (low) Energy Information Agency (EIA) projections. An example of EIA's conservativeness is their projection of the price of gasoline in 2030 to be $2.45/gallon. In this study, economically competitive models were often used and renewables had to compete with these very low EIA cost projections. Why bother to use EIA projections? These are the official U.S. government projections to be used by all government agencies. In spite of this assumption used throughout this study, the results show that carbon emissions can be reduced on a trajectory through 2030 to meet the 2050 goal of about 80% reduction compared to today. In addition, the overall cost savings by 2030 for the energy efficiency (EE) and renewable energy (RE) put in place in this scenario is at least $82 billion per year [101].

Since this projection of energy efficiency and renewables is cost competitive, there should be no extra cost incurred in the market place to reduce carbon emissions if this projection were to take place. Indeed, there should be direct cost savings without counting the reduction in the price of conventional fuels when the projected amounts of energy efficiency measures are introduced. There is some public investment over the next two decades for government research, design, and development (RD&D) and subsidies that are phased out by 2020 to help with the transition to meeting the carbon reduction goal by 2030.

This reduction of carbon emissions was accomplished by a combination of nine techniques based on energy efficiency and renewable energy options. A number of important options such as "clean" coal and "acceptable" nuclear were not part of this total. Nuclear and coal can play a role, but they are not acceptable in their current forms. However, these conventional energy options can be modified to contribute toward this carbon reduction goal using carbon sequestration for coal (see Section 5.1) and a host of achievable changes for nuclear (see Section 5.2). The measures needed

to achieve these vastly improved coal and nuclear systems will make these systems available in about a decade or two. The "acceptable" nuclear and "clean" coal options could be activated if the gains projected for energy efficiency and renewable energy do not prove adequate or if the needed carbon reductions are greater than now thought. Although the initial goal of preventing carbon levels exceeding 450 to 550 ppm appears to inadequate. More current work indicates that we should keep global CO_2 level stabilized below 400 ppm [147]. Automotive options such as the near-term pluggable hybrid electric technology and the longer-term use of hydrogen as an energy carrier are also ignored in this time frame till 2030. Energy conservation was not considered as part of these projections although this option can make a powerful contribution to the future reduction of carbon emissions. The potential of carbon sequestration in forests and other flora or changes in agriculture practices in the United States were not included, although there are many opportunities to use these options to remove carbon from the atmosphere if done on a long-term sustainable basis. These opportunities can be examined on other day.

6.1 TILTED PLAYING FIELD

The outcome of this study with minor exceptions was based on the energy efficiency and renewable options being cost competitive with conventional energy sources. All nine of these options were considered in a conservative manner and only used to the extent that they were attractive in limited regions of the country without modifications to our electric transmission system or the introduction of commercial-scale energy storage systems such as cost-effective underground compressed air systems. All in all, these results are conservative in almost all ways except one. It is assumed that all these decisions to use cost-effective energy efficiency and renewables took place on a level playing field not biased by the current influence of conventional energy system operators either politically or economically. This study assumes that the millions of people making countless decisions each do so based on economic self-interest and behave perfectly rationally.

If the desirable outcome of significantly reduced carbon emission can be achieved at very competitive economics, why are any policy changes needed for this outcome to be achieved? The basic reason is that there is not a level playing field for renewables and energy efficiency at this time.

The current energy system exists today as a result of a century of development, investment, and a physical, economic, and political structure created to accommodate the current conventional energy system. Power lines and pipelines are where they are now not to accommodate the vast potential of various renewable energy sources. There are located where they are to accommodate yesterday's conventional energy sources. The electricity pricing rate structure of today's utilities was not developed to their current form to accommodate user-owned on-site energy options. Examples of on-site systems are photovoltaics (PV) on buildings or commercial combined heat and power

(CHP) systems that would compete with retail electricity and fuels within the urban center. Current government RD&D subsidies were not designed to support energy options that are new and promising, and are to be the energy system of the future. Current government RD&D props up energy options that have a large industrial base of support and have been commercial energy systems for more than 50 years such as oil, gas, coal, and nuclear. Even the most recent National Energy Plan (2005) only allocates 5% of the plan's support to renewables.

An enormous amount of energy efficiency in all sectors of our economy are very cost effective, but there is little or no interest in taking advantage of these cost savings over the operational life of a particular system. Buildings have a 30- to 100-year lifetime, yet essentially zero percent of these buildings are designed to be energy efficient over their actual lifetime. Owners of industrial processes are overly first cost sensitive and corporations routinely reject 2-year breakeven improvements in process efficiency. Yes, American industrialists routinely reject process modifications with a 40% rate of return. So much for economic rationality.

Buildings almost always are built by people who do not live in them, so there is little incentive for the builder to worry too much about energy operating expenses. Even energy-intensive commercial diesel trucks are built to be energy cost effective over their first 3 years, although this equipment is used for 15 years. The reason is simple. The first owner typically uses the truck for 3 years. This type of list can go, and it would take a shelf of books to capture most of the examples.

So the good news is the transition to increased energy efficiency and renewables will be driven by the increasingly competitive energy economics [59]. The bad news is that the lack of a level playing field will delay the introduction and use of renewables as well as energy efficiency. Because of the delays that will result from this tilted situation, the time scale for this transition is out of step with the timing of the needed action on avoiding the worse impacts of climate change. Policy is needed to make the inevitable happen sooner rather than later when it will not do us much good. Why do I say that the delay won't do us much good? To meet an 80% CO_2 reduction works if we start in 2010. If were start in 2020, it will require an 8% per year reduction in CO_2 [147].

New rules are needed for all energy stake holders to use so that we capture the power of the market forces and yet avoid the worse impacts of global climate change. These new rules (policy) need to recognize the built-in structural disconnects between the old and new energy system, as well as the economically irrational decisions that are commonly made throughout our energy economy. New rules are needed to recognize the damage inflicted on all of us by carbon and other greenhouse gas (GHG) emissions that are not considered in current energy economics.

6.2 UNIQUE DIFFICULTIES WITH CLIMATE CHANGE

In addition, there are at least two serious sets of issues that make this seemingly straightforward task on introducing cost-effective energy efficiency and renewable energy difficult and bordering

on impossible. The first is due to the issues related to the unique aspects of climate change—it takes a long time to see the results of the carbon and other GHG overload of the atmosphere. Without seeing the negative results, it is hard to mobilize the needed political reactions to negate the problem. We are dependent on long-term scientific projections as the basis for our near-term mitigating actions. Using scientific studies as the basis for a political decision is particularly difficult for the United States. It is much more than U.S. scientific illiteracy illustrated by the example that only 26% of Americans think that evolution was caused by natural selection [148].

Also, our political system and its decision-making mechanisms are based on a relatively short-term time horizon of 2 to 8 years at most. Yet carbon dioxide (CO_2) residence time in the atmosphere is from 50 to 150 years. This is a large mismatch between the time scale of the problem and the time scale of our political horizon. Yet somehow, some political decisions supporting a particular project have had a much longer life. An example is the Interstate (Eisenhower) Highway System in the United States took about 35 years to complete and cost $425 billion in 2006 dollars. Another is the state of California's support for a bevy of measures to stabilize electricity consumption over the last 30 years while California has had a rather politically extreme sequence of governors.

There is some scientific uncertainty over the cause and effects of climate change although the uncertainty is decreasing over time. The current Intergovernmental Panel on Climate Change report [149] judges that there is a 90% probability that the current warming is human caused. Many people would think that 9 chances out of 10 are pretty good odds, but even that small uncertainty is big enough to drive a Hummer through if your world view normally does not recognize pollution as a problem. Also, global warming is caused by so many different human activities taking place all over the world in differing magnitudes and over different time scales of 150 years. This tends to get people pointing fingers at the other and makes any negotiation based on who is responsible and equity issues extremely difficult.

Finally, there is the North–South stalemate with the governments of the South pointing out that the Northern countries have thus far been responsible for the overwhelming majority of the GHG release (the United States, Europe, and Japan have contributed 70% of the total CO_2 dumped into the atmosphere to date). The South will be impacted more than the North and it is poorer with fewer resources to adapt. So the South argues that it would be unfair to require them to make any immediate contributions to preventing global warming. The North should go first and then help the South acquire climate-friendly technology. Meanwhile, the North points out that any reductions in their emissions would be rendered ineffectual if emerging countries such as Brazil, India, and China did not curb the growth of their GHG emissions.

Additionally, there is the ethical issue of differential damage. Projections of impacts (especially drought and water issues) will be especially severe on developing countries such as sub-Sahara Africa) and yet the developed countries caused most of the damaging GHG. How do you deal with this disparity?

6.3 A START

To get the policy ball rolling, let us look at a recent economic study by Nicholas Stern et al. called the Stern Report. This was a result of a call for an independent review by the Chancellor of the Exchequer reporting to both the Chancellor and the Prime Minister of the UK [150]. The bottom line was that from the many economic perspectives used by Stern, "the evidence gathered by the Review leads to a simple conclusion: the benefits of strong, early action (mitigating GHG emissions) considerably outweigh the costs." The Report goes on the explain that, "the evidence shows that ignoring climate change will eventually damage economic growth. Our actions over the coming few decades could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes. Tackling climate change is the pro-growth strategy for the longer term, and it can be done in a way that does not cap the aspirations for growth of rich or poor countries. The earlier effective action is taken, the less costly it will be."

The numbers from the Stern Report concludes that the annual cost of stabilizing the CO_2 level at around 525 ppm will be about 1% GDP by 2050 and further concludes that this is a significant but manageable level. Doing nothing, the Stern Report concluded, would cause damage from climate change that would cost the world between 5% and 20% of the world's gross domestic product.

Stern notes that most other study results to deal with climate change cluster between –2% and +5% of GDP by 2050 and says this is due to uncertainty and key assumptions such as the discount rate. Most of the criticism of the Stern report by economists seems to center on the discount rate assumption. The discount rate is the device used by economists to compare the economic value of something (usually money) today with tomorrow. It is a common feature of money market analysis to value different investments.

For example, Stern uses 1.4% for the discount rate and this translates into a trillion dollars in 2050 being worth $497 billion today. William Nordhaus looked at the same issues and used a 6% discount rate, which means that a trillion dollars in 2050 is worth $50 billion today. Quite a different result. The economists who attacked Stern accused him of making an ethical choice by using a relatively low discount rate. That is, he gave more consideration to future generations than a 6% discount rate would imply. They insisted that economists should not introduce ethical values into such calculations. In this case, what is the value of an investment today to prevent damages to future generations. Yet they insisted on using the 6% discount rate and said this was not injecting ethics into the analysis. They used 6% because it is commonly used by economists dealing with money markets. They seem satisfied that they were being ethically neutral with this stance. I wonder?

Yes, they are making an ethical value judgment as choosing any discount rate would imply. The question is, if it is okay to use a 6% discount rate, which is normally used to put future and

present money on similar footing. Is it okay to use this value when trying to consider today's dollars compared to tomorrows damages including loss of human life and species extinctions? This certainly is an ethical question of the highest order, and the economists who took issue with Stern need to do more than hide behind the discount rate used in money market analysis.

However, Stern's conclusion that "the benefits of strong, early action (mitigating GHG emissions) considerably outweigh the costs" does get us off to a running start in the attempt to formulate policy as a reasonable response to the monumental issue of dealing with human caused climate change.

6.4 ENERGY TRIBES

The second broad set of issues has to do with the makeup of our political beliefs system that governs all of our political discourse. There seems to be different sets of beliefs that are separate and not equal with almost no overlapping areas of agreement [151, 152]. This makes for difficult political decision making in the best of circumstances.

You may have noticed that some people believe that there are no environmental problems and that these pseudo-problems are simply opportunities. They think that all science on climate change is junk science (Senator James Inhofe (R) of Oklahoma). They believe that the only credible solutions to energy issues are developing more supply of existing energy forms and to let market forces dominate the outcomes. They also believe that the ablest should get the most rewards. Yet others feel that we cannot take a step forward without legion of experts who will guide our every step. Others yet, think, feel, and believe that humankind are flawed and the only solution is to withdrawal from engaging in any activity that has environmental impacts of any type. Furthermore, they believe that all corporations act in a crazed manner to generate growth in products, in profits, and in endless impacts. They perceive that this is the problem, and doing without is the solution. And there is an undercurrent of folks who do not believe any problem is solvable and people are beyond redemption. These are four sets of views, each dramatically different. It is important to note that we step into and out of these different forms of cultural values in different parts of our lives and sometimes often on a daily basis. These internally consistent holistic views of the world and coping strategies are not personality types [153].

I am sure you have met some of this cast of characters. How could you miss them, they are us! How do you form a rational approach to dealing with climate change when these are the people who make up who we are—when there are so many nonoverlapping sets of rationality? What common ground is there is move toward to fashion a solution to the difficult problem of human generated climate change?

The major question that must be answered before a coherent policy can be drafted to address climate change is, "policy for whom?"

If I suggest policy for all those that agree with my basic contentions, it would be a feel-good exercise for the subset of Americans that agree with me, but what about the rest? My policy would harden the resolve of some and drive them on to overturn the political influence of all these ill-advised folks. Others would say, do not waste your time with these futile attempts to solve this problem. Yet others would accuse me of selling out to the enemy if I offer any accommodation of other views. The last group would say I had some good ideas but I have not fashioned a proper structure to carry them out. Americans can only move forward if the suggested policy can be embraced by a large majority over the long term (100 years or more). So, how do you fashion public policy that deals effectively with the problems of excessive GHG and does so in a world made up of such an extreme set of pluralistic world views and value systems?

The major thing we have going for us is that we are a representative democracy. We need to use its basic structure to fashion a stable approach to this extremely difficult problem. That is, to be responsive to the electorates.

These different belief systems are core to each individual and allow them to function in society. Each brings their world view to each situation, which allows them to interpret what they are seeing, what it means, and suggests the tools that they can use to cope with the situation. More recent work by cultural anthropologists indicates that there is little or no overlap of these belief systems, and to make public policy without acknowledging this as a basic reality is doomed to failure. The cultural anthropologists call this study area cultural theory, and they call fashioning an approach to try to include these disparate views, clumsy solutions [154].

The first time these concepts were applied to the energy field was in the early 1980s, and it proved a difficult frame of reference to base national policy upon. The original sponsor of the study [Wolf Haefele, the director of the energy programs at the International Institute of Systems Analysis (IIASA)] refused to publish the work and it finally was made public outside the institute [155]. At that time, Caputo coined the phrase "energy tribes" as a short hand to describe these different sets of attitudes, beliefs, and solutions. More recent work [155] is now acknowledged by the very same prestigious institute as a significant insight in obtaining viable political support for public policy and promoted it through its institutional magazine [157].

This cultural theory gives the promise of allowing a public policy to be fashioned that acknowledges the very different ways that people see "reality"; it gives a basis for policy given the very different worlds that we live in. Taking advantage of the quarter century for this policy framework to move from rejection to acceptance (at least in IIASA), these different political and personal world views can be summarized as follows.

There are four primary ways of organizing, perceiving, and justifying social relations; and they are named by the cultural theorist: egalitarianism, individualism, fatalism, and hierarchy. These four ways of perceiving life and its realities are in conflict in every conceivable domain of social life.

What is important to this study is that these views include the different ways in which people perceive and attempt to stave off a threat such as climate change. Let us examine this conceptual basis for understanding our political climate to see how we can use it to deal with climate change in a democracy.

In the egalitarian social setting, they see nature as fragile, intricately interconnected, and ephemeral. Man is seen as essentially caring (until corrupted by coercive institutions such as markets and hierarchies). We must all tread lightly on the earth. It is not enough that people start off equal; they must end up equal as well—equality of result. Trust and leveling go hand in hand, and institutions that distribute unequally are distrusted. Voluntary simplicity (conservation) is the only solution to our environment problems. People who feel this way usually call themselves core ecologists.

In the hierarchical social setting, people see the world as controllable. Nature is stable until pushed beyond discoverable limits; and man is malleable, deeply flawed but redeemable by firm, long-lasting, and trustworthy institutions. Fair distribution is by need, and the need is determined by expert and dispassionate authority. Environmental management requires certified experts to determine the precise locations of nature's limits and statutory regulation to ensure that all economic activity is kept with those limits.

In the individualistic social setting, people view nature as benign, resilient, and able to recover from any exploitation. Man is inherently self-seeking and atomistic. Trial and error in self-organizing ego-focused networks (unfettered markets) is the way to go. They feel that those that put in the most in should get the most out. Inequity is good and a natural part of the world of people (note the glib acceptance by entrepreneurials of massive benefits paid to top executives in the United States as just and right). They think that institutions that work with the grain of the market are what society needs.

The fatalistic social setting finds that neither rhyme nor reason makes sense in nature. Man is fickle and untrustworthy. Fairness is not to be found in this life. There is no possibility of effecting change for the better. Learning about nature is impossible. For them, a reasonable management response would be, "why bother" [157].

How is this view of the basic human social reality useful in any political situation? Well, if this is us, then we need to adjust any public policy framework to recognize this. Either we acknowledge this reality or we are doomed to failure caused by the approach that makes sense to only a subset of the public. For a public policy to be successful, it needs as a first step to acknowledge the way we are no matter how seemingly untenable, and then to go from there.

It appears that cultural theory has several normative implications [158]. People are arguing from different premises and will never agree. Each way of organizing and perceiving distils certain elements of experience and wisdom that are missed by the others. Each needs the others because each is incomplete and only represents a part of what is needed [159].

For example, under pure egalitarianism (core ecologists), there is an endless search for consensus. There is no official leadership that can settle issues or voting mechanism that can be evoked. This lack of procedures for settling conflicts or differences of opinion can easily paralyze the egalitarian social setting. In addition, pure egalitarianism creates social ill by ruling out any activities that would give rise to inequality of condition. This limits economic production to a bare minimum. Clearly, this value system would have to be blended with others for society to function at all.

Hierarchy has a whole armory of different solutions to internal conflicts. Individualism preaches the right of each individual to live according to his or her own needs and wants without group interference. Together, these two provide many ways to increase the resource base of a people. Fatalism is useful for egalitarian organizations as it continuously replenishes the moral outrage that keeps such organizations together [160].

Hierarchy also needs others. Without the distrust of central control and the insistence on transparency that are prevalent within both individualism and egalitarianism, hierarchy would be apt to be prey to the classic problems of bureaucracy: corruption, arbitrary use of power, tunnel vision, lack of innovativeness, and moral fragmentation [161]. Unfettered individualism undermines itself because it does not include the means to enforce property rights as well as contracts nor does it have the means to check accumulating inequalities or recognize environmental damage. They need egalitarian-minded organizations to notice and protest mounting inequalities and environmental insults. It also needs the regulatory capacities of hierarchy to enforce property rights and contracts, as well as to organize the continuous redistribution of resources to maintain social stability [157]. With this as background, let us take a look at climate change through the eyes of cultural theory and see what it tells us and see if it is a useful frame of reference for policy. Three climate change stories will be presented through the eyes of the egalitarians, the hierarchists, and the individualist.

The egalitarians see the fundamental cause of excessive carbon emissions as a direct result of the profligate consumption and production of the North, the industrialized countries mainly in the northern hemisphere. The core difficulty is the obsession with economic growth—the driving force of global capitalism. This has not only brought us to the brink of ecological disaster, it has also terribly distorted our understanding of both the natural and social world. Global commerce leads us to desire environmentally unsustainable products while our real human needs go unfulfilled. These needs are living in harmony with nature and each other. Finally, global capitalism distributes the spoils of global commerce highly inequitably. The egalitarian heroes are those who see through the chimera of progress and understand that the fate of humans is inextricably linked to the fate of planet Earth. To halt environmental degradation, we need to address the fundamental global inequities. Their solution is that unless a policy or action can be proven to be innocuous to the environment, it should not be carried out. The affluent North will have to fundamentally reform their political institutions and unsustainable lifestyles. Rather than professionalized bureaucracies and

huge centralized administrations, we need to decentralize decision making down to the grass-roots level. Doing with less is the key strategy. Taking part in protests, lobbying, issuing research papers, and interfering with the juggernaut of progress all play in role in the solution to the climate change problem (http://www.earthfirstjournal.org/efj/primer/index.html, November 17, 2003).

The hierarchical view of climate change is quite different. It starts with a view of the limits to economic and population growth. The continued long-term use of oil, gas, and coal would eventually wreak havoc on the ecosystems on which humans depend. They do not believe the world is about to come to an end, and there is enough time to plan a gradual and incremental change toward energy options that do not emit GHGs. The underlying problem is the lack of global governance and planning that would rein in global markets and steer them in a direction to protect the global commons. The villains are those who are skeptical of the view that global intergovernmental treaties based on scientific planning and expert advice are what is really needed. The solution is for all governments to formally agree on the extent to which future emissions should be cut, which countries should do so, how and when. These governmental agreements should be imposed on the multitude of undiscerning consumers and producers within their borders. One should recognize that this is the logic behind the 1997 Kyoto Protocol.

The third story is that of the individualistic bent who view the recent public notice of climate change as much-ado-about-nothing. Just another attempt by naive eco-freaks who believe that the world can be made a better place by wishing it so, and by international bureaucrats looking to expand their own budgets and influence. They are skeptical of the diagnosis of climate change itself and they are convinced that even if it is correct, the consequences would not be catastrophic nor uniformly negative. For example, they point out that more CO_2 in the air would make things grow better. Climate change is not all that bad. This is not a unique environment catastrophe in the making. Rather, it is where we have always been—faced with uncertainties and challenges that if tackled boldly by a diversity of competing agents, can be transformed into opportunities from which all can benefit. They suggest a number of physical mechanisms that would undercut the scientific findings that support human-activated climate change. They see nature as wonderfully robust and bountiful. The answer is innovative business as usual [162]!

6.5 BASIS FOR STABLE POLICY

These three stories make sense to those embedded in each cultural system. They are viewed as incredulous by those in the "other" energy tribes. They give a plausible but conflicting view of climate change. None are wrong in the sense that they are implausible or incredible. Yet, none is completely right. They each have elements of what is needed. Trying to eliminate one or more of these "stories" would generate an incomplete and partially effective solution. Even more important is that each of

these voices represents a part of the political process. Without representing each of these distinct voices in democratic states would lead to a loss of legitimacy. Although these are contradictory perspectives on policy, none can be implemented on its own. Only innovative combinations of bureaucratic measures, risky entrepreneurship, and technological progress, as well as frugality and international solidarity could be successful.

Using cultural theory to gain an understanding of the different views we bring to the table of any public policy issue would suggest that to make things work for the long term you need to keep all players in the game. Excluding one or more views will not be effective in contributing to a comprehensive solution or to garnering political legitimacy. To do this is awkward and even labeled clumsy by some. It involves a noisy, discordant, contradictory dialogue that in the end needs to be responsive to all disparate parts. Success in using this approach to a difficult public issue would be a combination of public policy and entrepreneurship; and citizens' activities have contributed to the improvement of a pressing, collective problem without making something else worse [163].

An example of a failed policy that excluded all but the individualistic views is the George W. Bush administration's approach to controlling the price of oil. This is a significant problem as Chapter 2 points out and it is called it the first "hitting the wall." I believe that the sustained high price of oil it is ultimately caused by the peaking of global oil production. Outside of some moments of political peeve, the Organization of the Petroleum Exporting Countries (OPEC) has no interest in having the price of oil to too high or too low. Too high and alternatives will make an inroad. Too low and their profits are reduced. OPEC's approach to oil pricing is like the story of the three bears. They attempt to manipulate it to be just right. However, the sustained high price of oil will be the market response to continued demand while global production levels and then starts the long side down.

Bush and his administration, who function primarily as individualists, would not see any limits to production as a problem. Rather, they viewed the high and variable price of oil as solely due to constraint of market forces by the OPEC cartel. They viewed the problem as OPEC's manipulation, and they viewed the solution as destroying OPEC's cartel. This would be done by finding a way to invade a suitable OPEC country, Iraq in this case, taking over the oil fields, significantly increasing preinvasion oil production with help of U.S. oil companies. This would flood the oil market and drop the price, thereby destabilizing OPEC. The more politically insecure members of OPEC (where excess oil profits were buying political stability) would be ripe for U.S. oil companies taking over their production when they could no longer pay the bills (see Chapter 2).

By not inviting other points of view of the problem and of solutions, Bush's policy was doomed to failure. By not opting for the "clumsy" solution, and by blocking other voices, he has stumbled badly wreaking enormous damage in so many ways. He might consider the resulting mess as collateral damage to his heroic attempt to restore the core individualist's credo—the free and unfretted market. The core problem was his belief that he along understood the problem and

only he could fashion a clear and direct solution—the military option. Other points of view were unnecessary.

6.6 CAP AND TRADE

The European Union (EU) launched its initial attempt at the climate change cap and trade as part of the Kyoto Protocol in the Phase 1 agreement (http://ec.europa.eu/environment/climat/pdf/bali/eu_action.pdf). Initially, the Europeans were badgered into using a cap-and-trade approach by the Clinton administration who wanted a market-based approach to attract Republican support. The primary reason to attempt to structure an agreement that starts with the economically strongest nations and then extends to include additional nations and additional GHGs, is that limiting the agreement to a subset of nations would create a situation where the cost of energy and goods would be cheaper for those outside the agreement. This would lead to exporting industry and jobs to nations with carbon emission controls.

The EU approach was designed based on the Marrakech Accords of the Kyoto Protocol helped by the experience gained during the running of the voluntary UK Emission Trading Scheme in previous years (http://www.defra.gov.uk/Environment/climatechange/trading/uk/index.htm). Note was also taken of the U.S. cap-and-trade scheme on acid rain ingredients that has proven successful (http://www.edie.net/news_story.asp?id=6314).

The reluctance of largest GHG polluter, the United States since 1994, to engage in the negotiations has had a negative effect on the global expectations of success. At this point, almost none of the EU governments that have ratified the treaty have actually been fulfilling their requirements. Some critics point out that the Kyoto Protocol and the resulting EU Phase 1 agreement is based on the assumption that the prevention of climate change can only be provided through a formal, binding treaty between all governments. Furthermore, they say it has not identified and promoted competitive processes to help deal with climate change that can be much less costly or even a profitable undertaking [164]. They claim that the current Kyoto Protocol approach is based on only one way of valuing, the hierarchical one. This strictly technocratic and bureaucratic approach is at the root of many shortcomings of the Kyoto Protocol. These critics say that even if the Protocol is implemented, it will not prevent much global warming, stimulate economic growth, or empower destitute people. The cutbacks stipulated in Phase 1 are so small as to be insignificant compared to the worldwide 2050 goal of 50% reduction in GHG set by most scientists to stabilize the world climate.

Some of these criticisms have some weight. The Kyoto Protocol is cumbersome to implement and allows for three international implementation mechanisms: "international trading of emission permits", "joint implementation", and "clean development mechanism." The emission permit trading allows parties to comply with legal obligations to buy extra emission permits if it is cheaper than

other ways they could reduce emissions themselves. The joint implementation scheme allows industrialized countries to reduce their emission through projects undertaken in other industrialized countries. The clean development mechanism allows industrialized countries to meet international obligations by helping developing countries reduce their emissions. All three international schemes are difficult to implement because they require extensive monitoring and complex calculations.

The trading permits reward countries that have poor economic performance and penalize those who are economically more successful, and the permit scheme is expensive to implement [165]. Because the permits are allocated to individual companies, you have to judge whether individual firms are in compliance. This requires monitoring and high transaction costs [166], and governments may choose to avoid this cost by letting the companies self-monitor. This will open the door to cheating and fraud.

In addition during Phase I, most emission allowances in all countries were given freely (grandfathering). This approach has been criticized as giving rise to windfall profits, being less efficient than auctioning, and providing too little incentive for innovative new competition to provide clean, renewable energy.

The joint implementation and clean development mechanisms requires the establishment of a baseline. This would predict what future GHG the company involved would have been if the company had not received foreign funding. Agreeing on a baseline is difficult [167]. There also is a financial incentive to overstate the amount of emission that will actually take place. Some form of oversight on the proper implementation of these two schemes must be implemented. Finally, it is an open question if the Kyoto Protocol could even be expanded and includes all the countries left out of the first set of agreements.

Most players in the negotiation see the Phase 1 agreement to be a first step—a small first step. Given the complexity of a system designed to monitor and reduce a core economic commodity such as carbon, it makes sense that the first step should be a small one. Setting up the structure even in organized countries such as the EU is quite a challenge. This will be the first time most of the nations on the planet would be engaging in a joint program to reduce and control such as major commodity.

After this initial step, the EU in January 2008 has decided on major revisions to overcome some of the initial shortcomings. These changes include centralized allocation (no more national allocation plans), auctioning a greater share (more than 60%) of permits rather than allocating freely giving historical polluters a massive windfall, and inclusion of the GHGs nitrous oxide and perfluorocarbons to the other four primary GHGs. Also, the proposed caps are to be increased and are aimed at an overall reduction of GHGs of 21% in 2020 compared to 2005 emissions. These address a number of the shortcomings of the first version of the Protocol, but some major issues remain. Is this cap-and-trade approach based solely on an approach that would be inside the world view of

only one of the energy tribes—the hierarchical? The complexity of some of the mechanisms, and the high transaction cost for monitoring, opportunities for cheating and political manipulation, and finally, enforcing the agreement would lend support to this claim.

Cap and trade would also have a variable impact on consumers' power bills. During summer peaking loads in a hot spell or a really cold winter week, utilities would have to burn more coal to produce more power, causing their emissions to rise sharply. To offset the carbon, they would have to buy more credits, and the heavy demand would cause emission credit prices to skyrocket. The utilities would then pass those costs on to their customers, meaning that power bills might vary sharply from one month to the next.

That type of price volatility, which has been endemic to both the American and European cap-and-trade systems, does not just hurt consumers. It actually discourages innovation because, in times when power demand is low, power costs are low and there is little incentive to come up with cleaner technologies. Entrepreneurs and venture capitalists prefer stable prices so they can calculate whether they can make enough money by building a solar-powered mousetrap to make up for the cost of producing it.

Critics say a more effective, efficient, and equitable set of alternative policies may need to be developed. This would be based on involving all the "energy tribes" for all the reasons that the cultural theory suggests. This is especially important because a long-term approach needs to be developed because of the very long-term application of a consistent policy required to mitigate climate change. Only the involvement of all the different cultural value systems can maintain the politically stability needed for the long haul.

This criticism of cap and trade being hierarchical is curious because the major reason for a cap-and-trade mechanism is to set high-level standards that would achieve the needed reduction in carbon emission as determined by the planetary scientists and then allow market mechanisms to find the most cost-effective way to achieve this overall goal. This approach is supposedly aimed at using the market to make the thousands and millions of decisions each year to find the most cost-effective approach to reach a mutually agreed to goal. The shortcoming of the more traditional command and control approaches to environmental management is that it is often more expensive compared to the use of market-based economic incentives.

Cap and trade has been used successfully in the United States to address the acid rain problem in an economic manner. As illustrated in flawed Phase 1 of the Kyoto Protocol illustrates, the cap and trade must be well designed. Another example of a poorly designed program is the Bush Clean Skies program. It is not working because, "the cap is loose rather than firm, the governing rules are poorly designed rather than precise, the penalties for exceed the cap are low rather than significant, and the timetable for implementation is long rather than short," says Jeff Goodell [105]. When successful and failed examples of cap-and-trade programs are considered, what are the key elements that must be in the program? Using the outline provided by the Union of Concerned Scientists,

- Stringently capping emissions, with firm near-term goals. As discussed in Chapter 3, the United States must reduce its global warming emissions at about 80% below 2000 levels by 2050 to avoid the worst effects of global warming. Delay in taking action would require much sharper cuts later, making it much more difficult and costly to meet the necessary target. A near-term goal of about 20% reduction from 2005 levels by 2020 is essential.
- Including as many economic sectors as possible. The cap should cover all major sources of emissions, either directly or indirectly. They include electric utilities, transportation, and energy intensive industries, which together comprise some 80% of U.S. global warming pollution, as well as fossil fuel emissions from the agriculture, commercial, and residential sectors.
- Including all major heat-trapping gas emissions. Those include CO2, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Emissions of different gases could be combined according to their global warming potential using the CO2-equivalent method (http://www.epa.gov/climatechange/emissions/downloads06/07Annex6.pdf).
- Auctioning a substantial (60–80%) majority of emission allowances rather than giving them away to emitters. An allowance auction would allow the market to set the price of carbon, and it would be the most efficient and equitable way of distributing allowances. Giving away too many allowances would distort the market and could result in windfall profits for polluters.
- Using auction revenues for the public good. The government should invest auction revenues in clean, renewable energy technologies and energy efficiency measures. Revenues should also be used to ease the transition being stimulated in the following ways:

    - Compensate low-income families who have a larger part of their budget spent on energy
    - Provide transition assistance to workers or economic sectors that are disproportionately disrupted by the program, and
    - Help communities adapt to the unavoidable effects of global warming

- Excluding loopholes that undermine the integrity of the program. To be effective, a cap-and-trade program should not include a "safety valve" setting a maximum price for allowances and requiring the government to sell unlimited allowances to polluters once that price is hit. This would undermine the integrity of the emissions cap and reduce the incentive for investments in clean technology.
- Including strict criteria for cost-containment mechanisms such as offsets and borrowing. Offsets would allow regulated polluters to purchase emissions reductions from unregulated

sectors or countries that do not have caps, instead of reducing an equivalent amount of their own emissions or buying allowances from other regulated facilities. For example, a regulated electricity generator could pay an unregulated landfill company to capture its methane emissions and use those emissions reductions to "offset" their own. Borrowing would allow facilities to emit more global warming pollution if they promise to make sharper emissions cuts later. Offsets and borrowing could lower the cap-and-trade program's short-term costs for polluters. However, by postponing emissions reductions from major emitting sectors, they would delay much-needed technological innovation and jeopardize the program's long-term goals. Any offsets should meet rigorous standards to ensure the activities are permanently removing carbon from the atmosphere beyond what would happen in a business-as-usual scenario. Borrowing should not reach unsustainable levels that threaten the program's viability.

- Linking with similar programs. There are important economic advantages to linking a domestic cap-and-trade regime with those in Europe and other regions that have adopted a stringent emissions cap. Doing so would require the U.S. program's design to be compatible with these other regimes [168].

Even if this list of elements of a good cap-and-trade program is established, it is clear that cap and trade needs a lot of monitoring, certification, and oversight. The timeline of the cap goals must be set (negotiated). The actual market sectors to be part of the system need to be determined. The GHGs have to be stipulated. The percentage of giveaway and auctioned emission allowances must be set. The distribution of auction revenue must be determined. No high limit on emission permit trading cost (safety valve) should be included. Strict criteria for offsets and borrowing imply a lot of verifying, oversight, and management. Linking to similar programs in other countries such as the EU would require a lot of negotiation and process management. The long-term administration and oversight of a cap-and-trade system would have to take place over a long series of national administrations far into the future. Some of these administrations, if similar to the Bush government, would be seriously at odds with the whole purpose of a cap-and-trade program and could use government department appointments to undercut the program. This technique was amply demonstrated by his effectiveness in undercutting the environmental program designed and built in the 1960s and 1970s in the United States. We really do not want an approach that would be too vulnerable to manipulation.

It is interesting to note the results of an attempt to integrate the views of industrialists and environmentalists from the U.S. Climate Action Partnership's attempt to form a unified approach to climate change. The main consensus points are as follows: the cap on the CO_2 should be applied as close to the point of emission as realistically possible; between 25% and 80% of the all emission permits should be given away to major emitter for a transitional period; the law should provide

ample "offsets" available for purchase by companies failing to meet reduction targets; and "safety valves" should permit relaxed enforcement in case GHG reductions cause temporary economic hardship. These results were criticized because these are viewed as moving boldly in the wrong direction [169].

The point is made that to avoid the cap-and-trade program being overly complicated, that it should be applied where the carbon enters the economy rather than just before the carbon being emitted into the atmosphere. There are a much smaller number of carbon points of entry compared to the points of CO_2 release. The coal mine, the oil field, the ports, and the gas pipeline would be the 2000 points of entry. These entities would have to purchase emission credits from installations that have reduced their CO_2 emission. CO_2 emission reductions would take place at the auto factory and the coal power plant that increased efficiency, at the commercial building that was built to a Platinum LEED standard, etc. So you would still have many players that found it advantageous to reduce carbon emissions to earn credits, but a relatively few players at the source of the carbon entry into society would be purchasing these emission credits. It would simplify the bookkeeping.

The range of 25–80% for auctioning emission permits is too large. A substantial majority of these permits should be auctioned to avoid a windfall profit to carbon emitters. This range would have to be limited to 60–80% to limit the windfall profit. Even this 20% range of uncertainty would open the door to backroom dealing that would undercut the program. One of the major positive attributes of a cap-and-trade approach is that a cap is set on a timeline to get you when you need to go. The other is that the full complexity and innovation of the global economic system can be turned loose to find the enormous number of approaches that can be assembled to reach this goal in a economically effective manner (minus administrative costs and taken opportunities for fraud and cheating).

A revenue-neutral carbon dumping fee approach would have some of these features such as setting the tax and the reciprocal ways the tax would be redistributed to reduce the payroll tax and investment taxes. The GHGs that are part of the tax program would have to be identified. But once it is put in place, it would be vastly simpler to administrate and quite transparent. Manipulation would be difficult because there are a limited number of aspects of a revenue-neutral carbon tax approach and a tax is fairly transparent. However, to keep different nations on an even playing field, the magnitude of the fee would have to be similar for all nations. This assumes that an international negotiation takes place to establish the fee to be used by all. Although the structure of a single fee is very much simpler than the number and type of agreements in a cap-and-trade scheme, a fee requires a large number of nations to agree.

It is interesting that Gore recommended to Congress "that we should work toward de facto compliance with Kyoto. If we can ratify it, fine. But, again, I understand the difficulty. But we should work toward de facto compliance. And we have to find a creative way to build more

confidence that China and India and the developing nations will be a party to that treaty sooner rather than later" [170].

At the federal level, the acid rain program provides a good model of a successful cap-and-trade program that has greatly reduced power plant emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), the pollutants that cause acid rain and smog. Besides the shaky start of the EU-implemented cap-and-trade program in 2005, there are two other closer to home cap-and-trade programs that are coming on-line. The Regional Greenhouse Gas Initiative (RGGI), which will begin in January 2009, is a cap-and-trade program designed to reduce emissions from the electric power sector in 10 northeast and Mid-Atlantic states (www.rggi.org). In addition, six Western states and two Canadian provinces have launched the Western Climate Initiative to develop a regional cap-and-trade regime, and several Midwestern states are proposing similar programs as part of climate change legislation (www.westernclimateinitiative.org). California, the 10th largest polluter in the world, has set a cap of reaching 1990 levels of global warming pollution by 2020, and is moving to implement a suite of policies, including an emissions trading system, to achieve that goal (www.climatechange.ca.gov).

Key to cap and trade is to have bureaucratic measures aimed at overarching goals but designed to unleash competitive and creative market processes to achieve these goals. These goals would have to be structured differently for industrialized, emerging developing countries such as China, India, and Brazil, and countries that continue to stagnate economically. The industrialized countries would have a goal like the United States to reduce GHG by 80% by 2050, whereas emerging countries would have to limit GHG growth rather than reducing it initially. There eventually would have to be a reduction goal set even for the emerging countries so that the world average carbon emission reduction is about 50% by 2050. The economically stagnating nations would not have active goals but would have opportunities to end certain carbon emission practices such as slash-and-burn farming by being part of offset projects.

In addition to cap and trade driving down GHG emissions, poor (South) counties would be given the opportunity to locally produce and consume cheap forms of distributed renewable energy especially when you consider avoiding the enormous cost of the conventional energy infrastructure. There are many opportunities for a North–South exchange including renewable technology and incentives to end carbon emission practices like cutting down equatorial forests.

6.7 REVENUE-NEUTRAL CARBON DUMPING FEE

Although cap and trade creates opportunities for cheating, leads to fluctuations in energy prices, and has high administrative cost, carbon fees can be structured to sidestep all those problems while providing a more reliable market incentive to produce clean-energy technology.

A carbon fee simply imposes a fee (tax) for polluting based on the amount emitted, thus encouraging polluters to clean up and entrepreneurs to come up with alternatives. The fee is constant or to be increased in known amounts over time and thus predictable. It does not require the creation of a new energy trading market, and it can be collected by existing state and federal agencies. It is straightforward and much harder to manipulate by special interests than the politicized process of allocating carbon credits. It does not have the difficulties in figuring out baselines, offsets, and borrowing. It does not have to verify the carbon emission reduction in various energy sectors in the United States or abroad.

And it could be structured to be far less harmful to power consumers. Although all the costs and benefits of the traded emission permits under cap and trade go to companies, utilities, and traders, the government does receive revenue from the auctioning of emission permits. Essentially, all the added costs (fees) under a carbon tax would go to the government over the years. This revenue source could be used for several things such as to offset payroll and corporate taxes. So although consumers would pay more for energy, they might pay less income tax or some other tax. The idea is that taxes are not going up—they are being restructured. Less taxes on things we like (payroll, profits) and more taxes on things we do not like (carbon emissions). We already are quite good at collecting taxes, and the institutional mechanisms are in place. There is no need for a new elaborate bureaucratic institution that must tackle difficult problems identified earlier. Although cheating is possible in any tax scheme, the opportunities are vastly constrained compared to a cap-and-trade program. Although taxes are always a political liability, the cap-and-trade approach will also incur costs that will be passed on to the public which is essentially a tax. With a revenue-neutral carbon emission fee, the increased cost associated with carbon emission activities will be balanced by the equal reduction in payroll taxes or a per person rebate.

There is a growing consensus among economists around the world that a carbon tax is the best way to combat global warming, and there are prominent backers across the political spectrum, from N. Gregory Mankiw, former chairman of the Bush administration's Council on Economic Advisors, and former Federal Reserve Chairman Alan Greenspan to former Vice President Al Gore and Sierra Club head Carl Pope. Yet the political consensus is going in a very different direction. European leaders are pushing hard for the United States and other countries to join their flawed but improved carbon-trading scheme, and there are no fewer than seven bills before Congress that would impose a federal cap-and-trade system. On the other side, there is just one lonely bill in the House, from Rep. Pete Stark (D-Fremont) to impose a carbon tax, and it is not expected to go far.

The obvious reason is that, for voters, taxes are radioactive, while carbon trading sounds like something that just affects utilities and big corporations. The many green politicians stumping for cap and trade seldom point out that such a system would result in higher and less predictable power

bills. Ironically, although a carbon tax could cost voters less, cap and trade is being sold as the more consumer-friendly approach. A feature of a fee approach is that you are not actually reducing the amount of GHGs on a certain timeline as in a cap-and-trade to reach the goal that scientists determine. You are directly increasing the cost of emitting GHG and as a result you expect a reduction in emissions as energy efficiency, switching to alternatives and a whole hose of other things takes place. You would have to monitor the actual emission reductions and adjust the amount of the fee to achieve the results desired.

A well-designed, well-monitored carbon-trading scheme could deeply reduce GHGs with less economic damage than pure regulation. It would be so complex that it would probably take many years to iron out all the wrinkles. Voters might well embrace revenue neutral carbon emission fees if political leaders were more honest about the comparative costs [171]. The revenue-neutral carbon tax could be applied to all fossil fuel sectors including vehicle fuels even if a strong Corporate Average Fuel Economy (CAFÉ) standard is put in place. An aggressive CAFÉ standard that is incremented periodically would achieve the desired reduction in carbon emissions in the vehicle based on increasing efficiency. However, the second problem with vehicle use is the increasing mileage driven each year. Since 1983, the United States has added more than 60 billion miles per year to road driving, which is about 2% per year (Federal Highway Administration Office of Highway Policy Information Monthly). Even if increased CAFÉ standards improve vehicle efficiency, these gains will be eroded by the increase in miles drive. There needs to be an addition element beyond CAFÉ standards such as a revenue-neutral carbon dumping fee applied to petroleum products.

Beyond the CAFÉ standards, there is a strong need to give attention to a range of other issues such as improving public transport and reversing our approach to land development to reverse sprawl. Both of these approaches are important but will take decades to slowly put in place.

The revenue-neutral carbon dumping fee looks like it does a better job when viewed through the eyes of cultural theory. It does not create such a bureaucratic overlayer in an attempt to maintain the trading system and avoid gaming the system with various types of manipulation. Entrepreneurs should be giving encouragement to improving the process and design of innovation as solutions, not how to manipulate the system. The cost is predictable and business can operate with more assurance with a fee. They will know the rules and the rules will be less amenable to political manipulation once established. It is the policy for the long haul in a multipluralistic world. The cap and trade is less so.

6.8 PARALLEL POLICIES

Whichever approach is used, additional policy is needed to further level the playing field for renewables and to more quickly capture the increasing economics of renewables. For this global transition to take place, the basic economics must be favorable and competitive for it to happen at all [59].

As this study shows, the basic economics are favorable. The main barriers to rapid introduction of cost-effective energy efficiency and renewables in the United States are the current investment in conventional energy; the powerful political influence of oil, coal, gas, and nuclear interests; and the structure of the energy system that is based on conventional energy.

A revenue-neutral carbon tax or a cap-and-trade program alone would not be sufficient to meet the challenge of climate change. Although both would address the failure of the market to account for carbon emissions that harm to the climate, it cannot by itself provide sufficient incentives for the technologies and other measures that will be needed to establish a true low-carbon economy. Parallel policies are needed to ensure development and deployment of the full range of clean technologies. These policies include requiring utilities to generate a higher percentage of their electricity from renewable energy sources such as 20% by 2020 (Renewable Energy Portfolio Standards); requiring automakers to increase vehicle fuel economy standards (CAFÉ) such as 40 mpg by 2015 and increase by 3% per year after that; stronger energy efficiency policies such as a national building code modeled on California's Title 24 with carbon-neutral new construction by 2025; incentives for investments in low-carbon technologies (investment and production tax credits); and policies encouraging smart growth [168].

Studies have shown that a comprehensive approach including these parallel policies would lower the price for GHG emission allowances, cut emissions, and save consumers money by lowering their electric and gasoline bills. Office of Management of Budget (OMB) examining the McCain–Lieberman bipartisan cap-and-trade legislation (S139) for example and found that the economic results of this legislation tended to stabilize fossil fuel prices and accrue economic benefits to citizens. This amounted to $48 billion per year savings by 2020 and is in addition to the $82 billion saved by the energy efficiency and renewable energy strategy developed in Chapter 4. This is a total saving of about $124 billion/yr using this noncarbon strategy. The parallel policies included were renewable transportation fuels standards, renewable portfolio electricity standards, incentives and barrier removal for CHP systems, caps on other power plant pollutants—SO_2, NO_x, and mercury (as in S.843), and smart growth measures. Apparently, a functioning cap-and-trade program with reasonable parallel policy measures can reduce energy costs [172].

6.8.1 Research Investment

A strategy to move toward the reduction in carbon emission would entail a number of measures. To capture the fuller technical/economic potential of renewables, it is vital to redirect and significantly increase the RD&D budgets of the dozen or so countries that current account for 95% of the world energy RD&D [173]. Fortunately, the United States has enormous capacity to invest in RD&D and can be matched collectively by the rest of the industrialized countries. In 1999, the U.S. federal government alone directed $4.4 billion at all energy RD&D. At the same time, it poured abut $40

billion into military RD&D. Given that U.S. spending on the military (not counting the Iraq and Afghanistan wars) is about the same as all the other 190 countries in the world combined and the enormous U.S. military superiority, there is a significant opportunity to apply some of this misdirected military spending into the energy area. One can easily envision increasing the total energy RD&D by factors without affecting the U.S. overwhelming military superiority. Military superiority is not proving especially useful in the current Middle Eastern military engagement. If anything, a very superior military tempts certain politicians to use it inappropriately. In addition, by redirecting the DOE energy RD&D funding from conventional to renewable energy, it would make a real difference in bringing needed future advances into being quicker.

This also implies the removal of supports for conventional (oil, nuclear, coal, and gas) energy, which will not get us where we need to go and transfer this funding to renewables. This is easier said than done because of the vested interests of conventional energy giants. The key areas where RD&D would make a major difference in the renewable energy areas are PV for increased performance and lower cost, geothermal to develop Enhanced Geothermal Systems and technology to overcome limitations of depth, relatively low permeability, or lack of water as a carrier fluid for the heat energy, to renew the Production Tax Credit of 1.8 cents/kW·h for wind systems until 2010 and then smoothly phased out by 2020. A 30% investment tax credit for concentrating solar power system (CSP) to 2017 and then smoothly phased out by 2025. Biomass-electric systems are mature and only needs some stimulus to set up the small power plants in areas with ample agricultural, municipal and forest wastes with an adequate collection system. This support could be in the form of an investment tax credit as in the CSP systems. There is a great need to stimulate RD&D in the biofuels arena that is concentrated on lignocellulosic biomass as the feedstock. When the R&D is done, then development is needed to establish commercial feasibility. Stimulus could be provided by re-directing of the ill-advised corn-to-ethanol program price supports.

The projected gains in the building energy efficiency sector depended to some extent on RD&D in areas such as solid-state lighting, advanced geothermal heat pumps, integrated equipment, efficient operations, and smart roofs.

One renewable option not consider but one that deserves RD&D support is ocean energy. This is a large resource and located off-shore near many urban centers. Development is needed to achieve cost effective systems that can withstand the harsh ocean environment.

However, there are several examples where some RD&D for conventional energy sources is appropriate such as identified in earlier chapters for coal and nuclear and the current RD&D could be redirected to be more useful. For example, coal needs certified long-term sequestration sites if coal is to play a role in reducing carbon emissions, along with the demonstration of a number of new coal systems using different types of coal to provide the impetuous for the coal industry to make the transition to “clean” coal as discussed in Section 5.1.

Nuclear has a range of needed changes such as a new long-term waste disposal site or sites, removal of on-site wastes now in water pools to protected dry canisters in the interim, revamping of the NRC to restore its safety culture, actually insisting on new reactors being safer, that terrorism threats be explicitly considered by the NRC, that fast reactors and reprocessing nuclear wastes into weapon grade materials, along with a number of other specific changes listed in Section 5.2.7. The lion share of RD&D logically needs to be focused on all the renewable technologies to hasten the longer-term economic efficiency of these energy systems. Chapter 4 identified many specific RD&D issues with longer-term renewable technology opportunities.

It is important that the RD&D allocation be distributed among all technologies with potential to help the United States move away from carbon. For example, it was a mistake in the post-World War II era to invest almost exclusively in nuclear power. Finally, it is vital not to channel all public funds through one agency. Institutionally dynamics often lead to a point where blind spots emerge and distortions occur that are not self-correcting. Multiple RD&D agencies will ensure that institutional myopia is minimized [168].

Along with this increasing and refocusing of RD&D efforts, there is a government role to mobilize capital, to adapt infrastructure especially long-distance electric transmission, to shift taxes and subsidies, to provide resources to train installers and maintenance workers, encourage local governments and states to actively remove barriers to renewable energy systems and to engage in a dialogue with companies and citizens' groups to grasp the opportunities of energy efficiency, renewables, and conservation [157]. Some renewable options have protracted conflicts usually over siting issues. As in the case of the Nantucket Sound wind farm conflict, it proved useful to engage a public participation process that brought all parties together and allowed interaction with the project. The results proved satisfactory to about 80% of the participants [174]. This type of process is recommended for all renewable energy systems with likely public conflicts.

As with new coal plants, there would be a government role to stimulate new types of renewable plants to accelerate their acceptance. This is especially true for geothermal, some CSP plants, and some biomass systems. Early new types of plant could receive special incentives to assist the transition from advanced prototype to full-scale commercial systems in various region specific situations.

6.8.2 National Electric Transmission Grid

Some forms of renewables such as wind, concentration solar, and geothermal have a large national level resource, but only some of this potential is in near large urban load centers. These near urban center opportunities will be well on the way to saturation by 2030. Around 2025, initial links in a national electric transmission system are needed that will allow these large renewable resources to start achieving their national potential. Infrastructure upgrades are needed that are beyond the

normal and need to be addressed by the national government. After initial planning, this effort needs to get underway by 2015 to meet the goal of building the initial long distance links by 2025.

The national investment in a long-distance high-voltage DC electric transmission system is needed much as the Interstate Highway System was seen as a wise investment in the greater economic integration of the country. This would allow the efficient movement of CSP electricity from the southwest (seven states from western Texas to southern California) to distant urban centers. In a similar manner, wind from 20 states of the Midwest and West plus some coastal states, geothermal from western (16 states primarily from Louisiana to Washington), and agricultural states and the Southeast biomass wastes to electricity systems could be used in distant cities.

These four energy systems compliment each other beautifully in that they produce electricity around the clock. Geothermal and biomass-electricity are baseload (24/7), whereas some types of CSP (parabolic trough and central receiver) are a day-time electricity generator that can have inexpensive thermal storage on-site and be a midrange energy producer and operate comfortably up to 12 hours per day at rated power. Some CSPs (concentration PV and dish-Stirling) would generate electricity only during the bright sunlight hours (up to an average of 8 hours per day) and generate more daytime peaking power. PV on buildings is a midday energy generator. Finally, wind is more of a reciprocal to CSP generator and would augment the nighttime loads especially the emerging new large transportation load of pluggable hybrid-electric vehicles (PHEVs). These vehicles will initially allow the commuting mileage to be transferred to nighttime electricity in a much more cost-effective manner than using food (corn) as a source of vehicle energy. For the western renewables, the time zone difference of up to 3 hours would act like 3 hours of storage to extend power into the early evening.

This remarkable renewable energy combination is extraordinary and especially so if these large resources are connected via an efficient electrical grid that can be created only with significant support at the national level. The railroads were built with a strong role of the federal government, although it was a thoroughly entrepreneurial undertaking. A similar approach is needed in the creating of a truly national electric energy system.

In addition, there are some key reforms needs in the transmission area. An example is to institute a new innovative transmission tariff to provided long-term transmission access on a conditional firm or nonfirm basis. Such a transmission tariffs would speed the development of wind and other renewables and increase the efficiency of the transmission system.

Develop smart grid systems across the nation for a number of reasons but also to facilitate the nighttime charging of PHEVs as an interruptible load to allow greater use of wind power in a region.

Expand FERC Order 888 to explicitly ask individual transmission operators to offer alternative nonfirm service for periods longer than 1 year. Nonfirm service is not guaranteed, so service can

be interrupted under specific curtailment procedures and priorities and would allow wind. Alternative tariff could be conditional firm. The main characteristic of the conditional firm tariff involved a cap on the number of hours that the generator would be curtailed, or a long-term nonfirm tariff. This would give some renewable technologies greater access to the existing grid before the national grid is developed.

On-site renewable energy systems including PV, smaller version of CSP systems, hot water, solar air conditioning, on-site solar steam, and urban biomass-electricity systems generating electricity inside the urban center would not be part of the national electric transport system. As shown earlier, these all pay a significant role in growing our energy future.

6.8.3 Energy Efficiency Market Failure

In the vehicle and other energy efficiency areas that have such enormous potential, there is definitely a need for a policy role. There is a systemic undervaluing of life-cycle costs in the designing of vehicles, buildings, and industrial processes. To capture the creative entrepreneurial skills and yet achieve the cost-effective adjustments needed, industry-wide standards can and should be used. CAFÉ standards for vehicles were discussed earlier as a simple and effective way to increase efficiency in vehicle design that is cost effective over the life of the vehicle. Current technology can easily achieve 40 mpg by 2015. Improvements in current technology and improvements in pluggable hybrid-electric and eventually hydrogen-driven fuel cells could continue to deliver gains if driven by periodic CAFÉ standards upgrades (3% per year). A similar story can be made for aircraft since today fleet was not designed for $150/bbl or greater fuel costs. An interesting fuel for advanced commercial aircraft is liquid hydrogen, which could be independent of fossil fuels [175].

To support vehicle efficiency in addition to the evolving CAFÉ standards, a revenue neutral "feebate" program can be instituted where cars that achieve greater than then average CAFÉ standard are given a rebate of about $500 for each mpg over the standard. This rebate would be paid for by a $500 fee for each mpg under the standard at the time of the vehicle sale [176]. Alternative fuels should be supported by RD&D to bring superior techniques to market and with initial subsidies for new plants and facilities. However, the current practice of allowing dual-fueled vehicles mpg to be counted at double their actual gasoline based mpg rating is counterproductive. As currently implemented, the manufacturers are installing dual-fueled capability on vehicles with some of the poorest mileage characteristics. The dual-fuel capability is installed not because it is expected that these vehicles will use the biofuels; it is only being done to be able to build more of these gas guzzlers than would normally be allowed under CAFÉ standards. Other approaches exist to encourage dual-fuel capability without supporting this sham.

Public funding for public transport needs to be increased significantly, along with support for land use that helps public transport work more effectively. Smart growth has been talked about with great enthusiasm for decades as an alternative to suburban sprawl. The results to date are discouraging. It is time to take a serious look at what has been tried in different cities and pick a few winners, and then to design an approach that sets up policy that the private sector can function within and get where we want to go.

The equivalent of CAFÉ standards can and should be developed for buildings (residential, commercial and industrial). An example at the state level is Title 24 in California building code that has been used for the last 30 years to reduce building energy use throughout the state. California now used half the electricity per capita as the average of the nation that in large measure is due to the extending the building code to housing energy use. Title 24 requires that a particular building type use less than a certain amount of energy per square foot per year based on certified engineering estimates. This certification is needed for a building permit to be issued, and this idea can be taken to a national level. Key to this building energy efficiency standard is that there are no specifications on how this energy requirement is met. It is up to the architect/builder/owner to choose what collection of techniques works best and is most cost effective in their region and meets their esthetic tastes. The Vermont zero carbon program also has important lesions that can be taken national.

An interesting recommendation from Al Gore in the housing area is that we ought to set up a carbon-neutral mortgage association where all of the extra carbon reduction costs in new construction are set aside. They will pay for themselves in lower energy bills. But just like Fanny Mae and Freddie Mac, put them in an instrument that is separate from the base purchase price of the house. When you are closing on a house and you sign the mortgage, and they will say here is your Connie Mae home improvement package. You do not have to worry about paying for that because it will pay for itself [170].

This sounds close to a suggestion by the city of Berkeley to pay for home upgrades on existing homes that reduce energy use. In Berkeley's case, the city will provide the capital to finance the cost of the energy improvements with low cost municipal borrowing and this will be paid back via increase taxes on the property for a fixed period. Then, the home owner receives the benefit of reduced energy expensive without having to raise the capital.

This combination of buildings and vehicle policies that leave the entrepreneurials free to develop the techniques that are sensitive to the local markets and conditions seems to be an effective approach based on cultural theory. That is, to have the needed national policy developed and turning loose the individualistic value system to figure out how to actually achieve it. This approach that is not dominated by only one energy tribe and would be more effective in the long run than solutions that depend on only one way of thinking.

Another key element of California maintaining its electricity use per person at a constant value over the last 30 years in spite of increase home size greater use of electrical devices, was the

use of appliance efficiency standards. It would be wise to increase federal funding and periodically update appliance efficiency codes and standards and expand the Energy Star program.

Compact fluorescents have developed sufficiently with several colors of light (warm, blue, and in between), different shapes and sizes, and indoor and outdoor versions at prices that are sometimes under $1 per bulb in a bulk package. It is time to phase out the incandescent light bulb completely. This transition to compact fluorescent lightbulbs and solid-state LEDs will increase the energy efficiency of a particular level of light by a factor of 4 to 10. Part of this would be requiring that lamp manufactures make adjustments to accommodate typical slightly larger compact fluorescents in order to sell in the US markets. This recommendation is one of the few that relies on just the hierarchical value system, which is a specific technical solution imposed on the market. Although normally to be avoided, an exception is made in this case. As part of meeting the California building code Title 24 requirements, buildings do have some designated hard-wired fluorescent lights. Compact fluorescents are not included as part of a building code because they can be interchanged with incandescent bulbs by the building occupant. It is time to phase out incandescent over the next 5 years.

The third leg of the California success in not increasing its per capita electricity use for 30 years was the use of a wide range of energy efficiency programs using the local utility to run the program using public monies. There has been a mixed bag for these varied programs and often the utility is less than enthusiastic about saving energy. By decoupling the utility incentives so that they are rewarded for actively supporting energy efficiency measures, it would be possible to encourage the utilities to run programs more successfully. It also makes sense to open up these programs beyond the for-profit utilities and the municipal utilities. Bidding for these state contracts should be opened to nonprofit (such as the California Center for Sustainable Energy) and nonutility for-profit companies to more effectively use these public monies.

Time of use electricity pricing needs to be instituted throughout the country to give the consumers a clear market signal. They will be paying what the electricity actually costs to deliver for each hour of the day. In conjunction with this, smart meters are needed for a host of reasons. One vitally important reason is to be able to mound a display inside the home that shows the current energy use, current price, as well as a selection of other metrics to give immediate feedback to the building user about current use and cost. Other smart meter features is to have certain appliances on interruptible service at a more favorable price to allow active load management by the utility. A smart metering system can also accommodate remote electrical outlets that can permit electric vehicle charging to a particular customer using a credit card swipe for identification and billing. Also, PHEVs can plug in throughout the grid and provide grid backup in the form of both standby power (for reliability purposes) as well as to actually pump energy into the grid. Again, the swipe identification card will tell the utility who to send the check to at the end of the month for the energy services provided [177].

6.8.4 Energy Structure Blocks Renewables

Energy prices are heavily dictated by existing infrastructure for generating, distributing, and consuming energy. They are also dependent on many public institutions such as state and federal government regulation of energy markets. As a result, the government has quite a bit of influence over energy prices. Currently, these public institutions are structured toward conventional energy systems.

An example is the Public Utility Commission in California (CPUC), which regulates the private utilities such as the San Diego Gas and Electric (SDG&E) Company. It is interesting that installing an on-site PV system on a commercial or school building in San Diego that generates most of its own electricity will actually raise the electricity bill for most of these buildings. This certainly seems counterintuitive. It has to do with the CPUC allowed rate structure that SDG&E uses. A combination of fix charges, capacity charges, demand charges, and so on, drive the cost of electricity in some applications to be more with the PV system generating most of the on-site electricity than without the PV system at all. (After a lot of public criticism triggered by the electric bill going up for schools after installing a large PV system, these rates have recently been adjusted to be more favorable for an on-site PV system.)

Similar difficulties exist in many utilities for clients that install a CHP system on site. This type of system (CHP) that uses the waste heat from the electricity generation for on-site heating applications can double the efficiency of the fuel used. CHPs more than halve the carbon emission if fossil fuels are used, and it also offers economic advantages compared to buying both electricity and fuel for just heat. One would think this is a desirable system where even the specific site conditions are favorable. However, the rate structure of many utilities around the county penalizes this very attractive approach. So there is a significant role for governmental public utility commissions to examine the current regulatory structure and clean house. It is necessary for all state regulatory agencies as well as the federal agencies to make all the adjustments that encourage reduced carbon emission systems and, if anything, penalize high-carbon emission systems in their jurisdiction.

There is a role for the federal government that would hasten investments in carbon-neutral activities. The Securities Exchange Commission ought to require disclosure of carbon emission in corporate reporting. This would more quickly give information to investors about which corporations are more or less vulnerable to future carbon costs [171].

What are other policy mechanisms that make sense based on the insights of the cultural theory? There are a number such as a national renewable energy portfolio standard. An example would be a national goal of 20% renewables by the year 2020. States could have a more ambitious standard if they wish such as the 33% goal in California. This standard would apply to all private and municipal utilities as well as rural coops. Again, how to meet this standard is left up the utilities teaming up with individualistic energy providers. This goal can be raised periodically in a prudent way to steer the economy toward the U.S. 80% carbon reduction goal by 2050.

To expedite this goal, a number of supports are appropriate in the near term. Examples are either an investment tax credit or a production tax credit for all renewables. The magnitude of these tax incentives should be reduced over the next 20 years. This is a two-decade policy to help bridge the transition to renewable energy. The start/stop production tax credit that has characterized the past and current energy policy is really counterproductive. This type of uncertainty in the basic supports for renewables is incredibly disruptive to the energy market.

Upfront capital rebates are also a mechanism to encourage early energy systems, and it can be phases out gradually as market costs are reduced by increased production and learning curve efficiencies (see http://www.cpuc.ca.gov/puc/Energy/solar/). An alternate strategy is to pay an energy feed-in tariff for each unit of energy generated by renewable energy. Again, this can be used to stimulate renewable energy in early markets and phased out as commercial system decrease in cost.

Establishing a set of solar rights nationally to prohibit the infringement of building owners to access their solar resource could be based on successful state examples such as California. Also, having solar rights in place that are not infringed by local covenants such as municipalities or homeowner associations is very important [178].

When an on-site solar electric system is installed that is connected to the grid, this connection is called net metering. Excess electricity is pumped into the grid for sale by the utility to other users (usually during the day), and it is provided by the utility when electricity is needed (usually at night). The utility usually gets electricity during high prices times of the day and provides electricity for the most part during less expensive off-peak times. The utility usually can defer or avoid electrical distribution system upgrades because there are small-generation plants distributed along the lines. The home user buys and sells electricity at the same retail rate and does not have to put in an energy storage system. This is a win-win. It is important to establish national net metering and interconnection standards for on-site renewable energy technologies. The current mish-mash across states and counties makes it very difficult for renewable energy providers to function. Also, the net-metering law should not be limited to the energy used on-site. If extra roof is available beyond the needs of the building, then it should be up to the building owner to decide whether more of the roof is used to generate power. The amount that the building owner is paid for the excess electricity should reflect the time of day that it is generated. Allowing the full roof to be used will essentially double the on-site PV resource potential.

6.8.5 Conservation: Green Spirituality or Common Sense

Energy conservation did not play a role in the numerical projections of this study. Conservation is the vast array of voluntary actions that citizen and corporations can take to reduce their energy consumption. These can be accomplished during a relatively short time during an energy crisis or in the long term as a lifestyle change. A range of motivations could spur conservation from a civic

response to an energy emergency, to cost savings, to increasing environmental consciousness, to a core personal belief that makes a person one with the universe (egalitarians).

This important energy option is a key strategy of the egalitarians, and as a matter of government policy, it should be encouraged at every opportunity. Because a substantial number of citizens see conservation as vital, programs to bring them together physically and electronically should be developed. Workshops, conferences, seminars, books, magazine articles, blogs, and so on, should be encouraged as part of a government-supported programs. This needs to done recognizing that this makes enormous sense to some Americans and not others. The program design needs to recognize and try to avoid presenting these ideas as something for everybody and make sure the design of the program is aimed at those who would understand and use these ideas. Others in society with a lesser intensity of their motivation for conservation could also be encouraged as a part of our overall approach to sound energy policy. The potential benefit in emission reduction is potentially enormous and difficult to estimate without some program results.

The climate change crisis is at its very bottom, a crisis of lifestyles. Some might even say it is a crisis of character. The United States is the third largest oil producer on the planet (after Saudi Arabia and Russia). Yet we do not live within this very large production capacity. A similar thing can be said about the size of our houses, the size of our cars, and so on. Why is it not reasonable for us to live within our energy means? Why is our culture so dependent of spending as an act of virtue? There could be an appreciation of a simpler life with other virtues besides spending money. The big problem of overloading the planet's atmosphere is nothing more or less than the sum total of countless little everyday choices. Most of these are made by us (consuming spending represents 70% of our economy), and most of the rest is made in the name of our needs, desires, and preferences. What would happen if each of us went green?

Sometimes you have to act as if acting will make difference, even when you cannot prove that it will. This, after all, was precisely what happened in Communist Czechoslovakia and Poland, when a handful of individuals such as Vaclav Havel and Adam Michnik resolved that they would simply conduct their lives "as if" they lived in a free society. That improbable bet created a tiny space of liberty that, in time, expanded to take in, and to help take down, the whole of the Eastern bloc [179]. Conservation warrants serious attention as an energy option. It would take a combination of very creative government-supported policy and a grass-roots campaign to ignite a broad back-to-green movement that could sweep this county and the world. Why not?

6.9 WHAT TO DO WITH COAL PLANTS

The 800-lb gorilla in this chapter that has not been directly faced is the question of what to do about coal plant carbon emission? Will a revenue-neutral carbon tax or a cap-and-trade program handle it? Section 5.1 logically looked at the coal situation and came up with a coal strategy that:

- Increases RD&D for CO2 sequestration.
- Establishes a national Carbon Sequestration Commission to certify sites for long-term CO_2 impounding and give oversight to the national sequestration program.
- Suggests government support for the demonstration of the newer technologies (IGCC and oxy-fuel) at full scale with CO_2 sequestration in different utility and geologic environments with different grades of coal.
- Bans all new conventional coal plants without sequestration at certified sites.
- In the near term, encourages efficient natural gas combined cycle (CC) plants to replace older coal plants and to be used instead of new traditional coal plants. (This type of gas plant generates less than half the CO_2 of today's coal plants at a cost less than a new coal plant with sequestration.)
- In the near term, encourages biomass co-firing with coal.
- Encourages efficient existing coal plants that happens to be sited in a good CO_2 sequestration area to be retrofitted with the oxy-fuel process that allows clean operation and the separation of CO_2.
- Encourages new IGCC and oxy-fuel coal plants to be built near good sequestration sites to finally retire all the remaining old coal plants.

This certainly would do the job, but the problem with this is that is uses the words "ban" and "encourages." The question is how? How to do design an approach that uses cultural theory and present a strategy that includes the various views of reality? The first three elements of the strategy are all federal government roles to invest in sequestration RD&D, supporting new large plant demonstrations, and setting up a new commission to oversee the certification of sequestration sites and their long-term stability. However, the final five elements are all top-down command and control solutions. This is the type of thing that the hierarchy social setting would support without any involvement of the individualistic or the egalitarian approach and would be a poor policy approach.

The cap-and-trade policy mechanisms suggested earlier would certainly put a cost on carbon emissions that would "encourage" the substitution of combined cycle gas plants for coal and the move toward to sequestration of CO_2. It would not ban new coal plants outright. However, anyone planning to build a new conventional coal plant knows that their plant will not be grandfathered in to avoid future carbon costs. These new coal plants will have the financial burden of having to buy emission rights or pay a carbon emission fee. The emission trading market will find the value of the emissions, and it will have less to do with the "cost" of the carbon pollution and more to do with the cost of mechanisms to reduce carbon emissions. That could be a combination of things such as plant efficiency improvements, using lower carbon content fuel, or sequestering the CO_2. It

could also be a combination of energy efficiency improvements in another sector of the economy, or paying tropical counties not to cut down their forests, etc. Whatever is the lower-cost approach to reducing carbon emissions plus the cost of administration of the complex cap-and-trade scheme, and somehow shielding it from political manipulation, it really is a carbon emission tax hidden in the form of a market of emission credits.

The other way to make carbon emissions expensive is a direct carbon emission charge via the revenue-neutral carbon dumping fee. Although you do have to calculate the amount of carbon a particular plant emits, it is a vastly simpler way to make carbon emissions cost something. But, how much should the carbon emission charge be?

One approach is for the carbon dumping fee to be priced to make a new conventional coal plants more expensive compared to the currently available commercial CC natural gas plant that emits half the CO_2. Based on current national average fuel prices [delivered cost of coal at \$3.0/MBtu [180] and natural gas to electric utilities at \$10/MBtu (2007) (EIA)], the carbon tax would have to be greater than \$100/ton of carbon (\$27/ton of CO_2). The energy cost of both plants would be 11.7 cents/kW·h with this fee compared to the no carbon fee cost of the natural gas plant cost of 10.3 cents/kW·h and the new coal plant cost of 7.5 cents/kW·h. Because the regional price of delivered coal varies from about \$2/MBtu to \$6.00/MBtu, half the new coal plants would still be cheaper than a CC natural gas plant at this nationally average breakeven carbon tax of \$100/ton [181].

For the natural gas plant to be less than the new coal plant at the lowest regional delivered cost of coal, the carbon tax would have to be greater than about \$130/ton carbon (\$35/ton CO_2). Using this approach, the carbon tax would be sensitive to the delivered price of natural gas. If natural gas became more expensive, than the breakeven carbon tax would have to be incrementally above \$130/ton for gas plants to be less expensive than a new coal plant. And pushing new plant construction to using natural gas would certainly put pressure on the price of natural gas.

When the sequestration sites are ready and the new coal plants are demonstrated, this approach can be used to compare a new conventional coal plant at 7.5 cents/kW·h to a new IGCC plant with carbon sequestration based on a projection of 10.1 cents/kW·h (coal national average delivered price of \$3/ton). What would the carbon dumping fee need to be for the carbon sequestration plant to be the same cost? The revenue neutral carbon dumping fee would have to be the same as before, that is about \$100/ton (\$27/ton CO_2) if 90% of the CO_2 is captured. For a sequester coal plant to be less expensive than a new coal plant at the lowest regional coal price, the carbon tax would have to be more than \$90/ton (\$25/ton CO_2).

Using this approximate calculation as a guide, at a revenue neutral carbon dumping fee of \$150/ton (\$41/ton CO_2), the market would initially try to build CC gas plants that is a known technology with much commercial experience instead a new coal plant. This would reduce carbon

emissions for each new natural gas plant by about half compared to the coal plant not built. As the sequestration sites were certified and several coal sequestration demonstration plants were built, coal sequestration plants would become a commercial option. This $150/ton carbon tax would be more than enough (greater than the breakeven $100/ton of carbon) for sequestration coal plants to be built compared a conventional coal plant or a CC gas plant at today's gas price. This would be especially true if the natural gas price rose above $10/MBtu. A properly priced carbon tax would drive new fossil plant construction first to efficient CC natural gas plants and then to sequestered coal plants once they are demonstrated.

This tax could be instituted over a 10-year period. For example, it could start in the first year at $75/ton ($20/ ton CO_2) and then be increased by 15% every 2 years until it is $150/ton ($41/ton CO_2) in 10 years. This predictable change in the rules of the carbon business would tend to mimic the strategy developed in Section 5.1. It would also let the individual cultural preferences of people function with these new market conditions without an overburden bureaucracy associated with the cap-and-trade approach. This vastly simpler mechanism deserves a full hearing. If presented as a "revenue-neutral carbon dumping fee" (not a tax) and is directly connected to reductions in payroll and other wealth producing taxes, it should be acceptable to most Americans. The concept of shifting taxes so that we tax bad things more than good things should not be a hard sell. It almost appears that the main thing that cap and trade has going for is it is that you do not call it a tax, although it essentially is a tax whose price is variable and determined by emission trading. The list of cap-and-trade negative features is long, and we should pause and ponder a long time before deciding to use this policy mechanism.

The other important difference between the carbon fee and cap-and-trade is that the tax will start having a significant impact on the day this provision is implemented. All coal-related financial decisions will take the $130/ton carbon fee into consideration, although it is introduced over 10 years. Coal decisions for the most part are long-term decisions because the power plants last 60 years or more. Cap-and-trade will have a lower cost of carbon initially, and the initial impact on coal plant decisions will be to increase the financial risk of a relatively unknown amount of the emission fee that will increase over decades in an unknown amount. Coal plants will still get built, but the financial costs will reflect this increased risk. It is difficult to estimate the rate that new coal plants will transition to other lower carbon choices. The early actions under cap-and-trade will be to pick the low hanging fruit, which will be to pay someone in South American not to chop down trees and someone in China to build a wind farm instead of a new coal power plant. These are all good things if they are "real"—how do you tell if the "plan" to cut down the trees or build a particular coal plant was real. However, the United States will build 40 instead of 50 new coal plants that will be pumping out CO_2 for 60 years with a cap-and-trade scheme. With the carbon fee implemented next year, the United States may not build any new traditional coal plants.

This study shows that the combination of energy efficiency and renewables is a cost-effective solution. The use of a revenue-neutral carbon fee addresses the issue of the currently tilted energy playing field and tends to level the field. It also addresses the need to make this transition sooner rather than later. As we move further away from carbon via these technical and policy recommendations, the impact of the extra cost of the carbon will abate as cost-competitive options are put in place.