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A Strategy for American Power:
Energy, Climate and National Security

By Sharon Burke and Christine Parthemore
Contributing Authors: Josh Busby, Christine Matthews,
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Cover Image

Composite image depicts an iceberg near the Antarctic Peninsula and firefighters bringing water to a burning well in Kuwait.

Images from IStockphoto — 2006 (left) and Getty Images — 2008 (right).

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About the Solarium Strategy Series

The CNAS Solarium Strategy Series draws its name and inspiration from an effort undertaken by President Dwight D. Eisenhower in 1953. The original Project Solarium was a competitive strategy development process that is credited with helping articulate several pillars of American Cold War strategy. Through a similarly structured process of inclusive debate and extensive analysis, CNAS has developed several strategy documents that are designed to serve as useful inputs to the broader national debate over U.S. national security in the post-September 11 era. They are available online at www.cnas.org.

A Strategy for American Power:
Energy, Climate, and National Security

American Power: Energy Security Talking Points

THE MESSAGE

To protect the American way of life and secure the future, the United States needs a strategy that will cut both our dependence on oil and our greenhouse gas emissions. Today, the energy we use keeps our economy and security dependent on unstable and hostile states, vulnerable to natural disasters, and subject to the consequences of climate change. With a comprehensive strategy to change both our supply of fuels and our demand, the United States can win the energy war, just as the strategy of containment helped win the Cold War.

Background

Americans consume 22 million barrels of oil per day, 60 percent of it imported from other countries. Given that U.S. domestic oil production has been in decline since about 1970, the amount of imports will continue to rise.

The United States does not have much room to maneuver around this dependence. Ninety-six percent of road transportation (approximately 242 million vehicles) depends on petroleum products (gasoline and diesel), with little ability to change that in the near term. In turn, every sector of our economy, from agricultural to industrial to residential, depends on transportation for productivity.

Most global oil suppliers are hostile to the United States, unstable, undemocratic, corrupt, or some combination of these factors, which puts global supplies at risk and drives up prices. Of the top ten holders of reserves in the world in April 2008, all but one are considered to be failed states or in danger of becoming failed states, according to the Failed States Index.

U.S. energy vulnerability is likely to increase as oil falls into fewer and fewer hands, which is inevitable given that two-thirds of oil reserves are in the Middle East. The productivity of reserves is declining almost everywhere else, and global demand for oil is ballooning (demand is forecast to increase about 46 percent in the next 25 years).

The next largest fuel source in America, electricity, is 50 percent dependent on a highly polluting fuel, coal. At current rates of consumption, the United States has enough coal to last some 200 years.

Coal is the number one contributor to manmade greenhouse gas emissions, and there is a strong, scientific consensus in the United States and around the world that these emissions are changing the global climate.

Emissions have been growing fast—by 70 percent between 1970 and 2004—and will have to be cut dramatically over the next 40 years (between 70 and 90 percent) in order to avoid the worst effects of climate change. The United States is projected to experience a full range of effects, from warming temperatures to severe and unpredictable weather.

Talking Points

- True energy security means protecting our way of life and our future from the security, economic, and environmental risks associated with fossil fuels.
- The United States needs an energy security strategy the entire nation can support in order to cut our dependence on oil and our emissions of greenhouse gases.
- The temptation today is to address oil dependence and climate change as separate issues, but that would be a serious mistake—energy security means we need to address both challenges together or we may well improve one at the expense of the other.

Oil Dependence and Climate Change

- Americans are relying on unstable and hostile states for our oil supply, a problem that will only get worse over time as more countries use more oil and fewer are able to supply it.
- The oil market is global. Even if oil prices go down, we will still be vulnerable to hostile and unstable suppliers and damage from natural disasters.
- Both oil and coal are contributing to global climate change, which could have terrible security consequences as nations around the world, including the United States, struggle with droughts, food shortages, floods, heat waves, and unpredictable and severe weather.
- Climate change is a near-term problem. Even though the worst consequences may not occur for decades, our actions today will determine just how bad those consequences will be.

The Energy Security Strategy

- There is no silver bullet when it comes to energy security, but there is much we can do to protect ourselves.
- America needs a strategy for dealing with this threat, just as the strategy of containment helped the United States to prevail in the Cold War.
- A 70-40 strategy—cutting greenhouse gas emissions by 70 percent over 40 years—will reduce U.S. dependence on fossil fuels.
- The strategy will change America's fuel supply and its demand for fuels.
- First and foremost, to change our fuel supply and demand, we need to invest far more in innovation—there is great hope for the future, most likely through a combination of innovations, such as new fuel sources, electric cars, and carbon capture and sequestration.

- There may not be any silver bullets, but there are silver linings: an investment in energy innovation is an investment in our economic future and competitiveness, with new, high-quality jobs at home.
- The second thing we can do is tap America's most neglected energy resource: efficiency. By using energy more efficiently everywhere — in cars, with light bulbs, in buildings, and in power plants — we can rely on a domestic resource with no security or environmental downsides and actually save money over time.
- Finally, we have to do more at home and with friends and partners overseas to protect the energy infrastructure and prevent a crisis. We can't let terrorists who attack oil fields or power outages from natural disasters derail our nation.

How We Make the Strategy Work

- Leadership is essential: the next president of the United States and the next Congress must make America's energy security a top national priority — this is a matter of our security, our economic strength, our health, and caring for the land.
- The leaders and opinion-makers who shape public life in America need to do more to share good information and motivate Americans all over the country.
- The American public understands the risks and dangers of the current situation, but all Americans have to play a bigger part in meeting this challenge. Energy security requires a national strategy, but it also requires the individual acts of millions of people.
- The United States should work in partnership with more nations — China is a country we can cooperate with to make sure we both have the energy we need at prices we can afford with a climate our children can prosper in.
- The next president must raise the importance of energy security and stability as a foreign policy priority, particularly with some of our closest partners and allies, such as Mexico.
- If an oil crisis does come, Americans need to stick to the plan, pull together and stand strong, the way we did after 9/11 and Hurricane Katrina.
- Energy security is not a Democratic issue or a Republican issue — it's an American issue: for the security of the nation, Americans need to come together to cut down our oil dependence and lower the risk of climate change.
- We have an obligation to protect our children. We have an obligation to secure the nation. We have an obligation to be good stewards of the Earth.

Strategy Papers

June 2008

A Strategy for American Power:
Energy, Climate, and National Security

A STRATEGY FOR AMERICAN POWER: ENERGY, CLIMATE, AND NATIONAL SECURITY

By Sharon Burke and Christine Parthemore

Introduction: Why America Needs an Energy Security Strategy

The United States is engaged in a new war, and it is a war like no other in our history. Today, we are at war with the gas pump and the power plant—and the gas pump and the power plant, for the most part, are winning.

These strange foes can be explained in a handful of numbers:

22 MILLION:	Barrels of oil Americans consume every day.
60 PERCENT:	U.S. oil demand met by imports.
96 PERCENT:	Cars on U.S. roads that rely on oil products.
TWO-THIRDS:	Global oil reserves in the Middle East.
46 PERCENT:	Forecast increase in global oil demand by 2030.
50 PERCENT:	U.S. electricity that comes from coal-fired power plants.
200 YEARS:	How long America's coal reserves would last at current rates of consumption.
70 PERCENT:	Growth of U.S. greenhouse gas emissions between 1970 and 2004.
70 – 90 PERCENT:	Approximate greenhouse gas emissions the United States would have to cut in the next 40 years to avoid the worst effects of climate change.

These numbers add up to a tremendous vulnerability. The United States is dependent on geopolitically problematic and polluting oil, and the most likely substitute, coal-fired electricity, is even worse for the Earth's climate, with grave implications for future national security.[1]

The picture behind the numbers is no less troubling. With domestic oil production in decline since about 1970, the United States increasingly depends on other nations to meet its needs. Many oil suppliers are hostile to the United States, unstable, undemocratic, corrupt, or some combination of these factors, which puts global supplies at risk and drives up prices. Moreover, national oil companies (NOCs) hold about three-fourths of proven global reserves, even more by some estimates.[2] Other nations, most recently Russia, have become adept at using energy as a political and economic lever of power. In addition, terrorist groups such as al Qaeda view America's reliance on an exposed energy supply system as the West's Achilles' heel and a source of asymmetric power.

This vulnerability is likely to increase as oil falls into fewer and fewer hands, which is inevitable given the high concentration of reserves in the Middle East, the declining productivity of reserves almost everywhere else, and the ballooning global demand for oil. Although Americans consume far more energy per capita than any other population and far more oil in our transportation sector, the same pattern of dependency and vulnerability is repeated in consumer nations all over the world, from Berlin to Beijing.

The United States does not have much room to maneuver around this dependency. There are about 242 million vehicles in America, and almost all of them run on petroleum-based fuels: it would be economically and technically very difficult to quickly convert that fleet of cars, buses, and trucks to anything else right now.[3] In turn, every sector of our economy, from agricultural to industrial to residential, depends on transportation for productivity.

In 2008, oil prices have repeatedly crested new heights, bringing home this vulnerability and causing hardship across the United States and around the world. But Americans see this as more than an economic issue now: recent public opinion polls confirm that the public for the first time believes that dependence on foreign oil is the number one security threat our nation faces today.[4]

At the same time, the most immediately available alternative to oil for the United States, electricity, is 50 percent dependent on a highly polluting fuel, coal. Technology for burning coal and coal resources are prevalent in the United States, and given that the cost of dealing with its carbon dioxide pollution is disassociated with its price, coal seems relatively cheap. Another ready alternative, natural gas, would need more major discoveries in order to displace oil or coal.

Indeed, the vast majority of the energy the United States and other nations use today comes from coal, oil, and natural gas, all of which contribute a large fraction of the manmade greenhouse gases to the atmosphere (natural gas much less so), spurring changes in the Earth's climate. The Earth has certainly experienced dramatic changes in the climate before, but not in the history of human civilization, and never before as a result of human activity. Without concerted, global action starting within the next decade and sustained through the current century, the incredible ingenuity of Americans will be stretched to its limits by rising temperatures, declining availability of fresh water, increasingly erratic and extreme weather, and rapidly rising sea levels.

The temptation today is to address oil dependence and climate change as separate issues, but that would be a serious mistake. The energy security problem is complex and interdependent, and the solution will be complex and interdependent, too. To address oil and climate change in isolation would only risk improving one at the expense of the other. Both have the potential to derail the American way of life, and both are immediate problems—the effects of climate change may not be fully manifest for some time, but everything we

do today will determine how serious those effects are in the future. These challenges are directly linked—a strategic approach can help the United States develop a more systemic approach to dealing with them.

In addition, at a time of increasing budget constraints and with a globalized energy market, the United States needs a strategic framework to identify what is of greatest importance, how to allocate scarce resources and motivate multiple actors, and how to establish again a competitive edge (or leadership) in the world while promoting innovation and creating new jobs. Indeed, the uncomfortable reality right now is that there is no answer: there is no clear mix of policies that will provide the long-term solution to America's energy and climate security. A long-term strategic framework, however, will allow governments, businesses, and individuals to adapt and adopt new policies and approaches over time in a controlled fashion, particularly as new geopolitical circumstances and technological developments arise.

Solarium II: A Strategy for America's Energy Security

On January 10, 2008, the Center for a New American Security hosted a meeting of experts to discuss how a more strategic approach might help the nation meet these formidable energy challenges. The meeting was patterned after President Eisenhower's "Project Solarium," a 1953 policy exercise that competed alternative strategic options for winning the Cold War, ultimately resulting in Eisenhower's "New Look" strategy and many supporting policy choices.[5] Participants read in advance five papers produced by subject matter experts in advance, and came prepared to discuss and debate alternative options.

The Project Solarium II for Energy Security included individuals from all sectors of society—there were participants from the business, academic, nonprofit, and governmental communities. There was a cross-section of expertise and interests represented, ranging from information technologists to climate scientists to national security strategists—a group that does not necessarily consult together on policy issues. The sponsor of the event, the Markle Foundation, is a private philanthropic foundation with no direct interests in the energy sector.

This intramural, independent group provided an important blend of thinking. Too often, when it comes to energy security, differences of opinion can reflect vested interests more than divergent philosophies. Allies of the coal industry advocate for greater use of clean coal; allies of the solar power industry advocate for concentrated solar; allies of conservation advocate for efficiency; allies of the oil industry advocate for more drilling, and so on. That is not to say that any of these ideas are wrong—all are policy options that may well be a part of the solution. But none of these alone will suffice when it comes to dealing with the energy challenge the United States—and the world—faces right now.

Fortunately, a number of recent studies and statements have looked more broadly at the range of policy options for achieving energy security, getting past the vested interests.[6] CNAS found in these studies a surprisingly high degree of agreement on the measures needed to deal with the challenges of energy supply and climate change, and this finding was borne out in two Energy Security Solarium meetings. In the literature and in the meetings, however, there was far less agreement on what it will take to actually make those measures work.

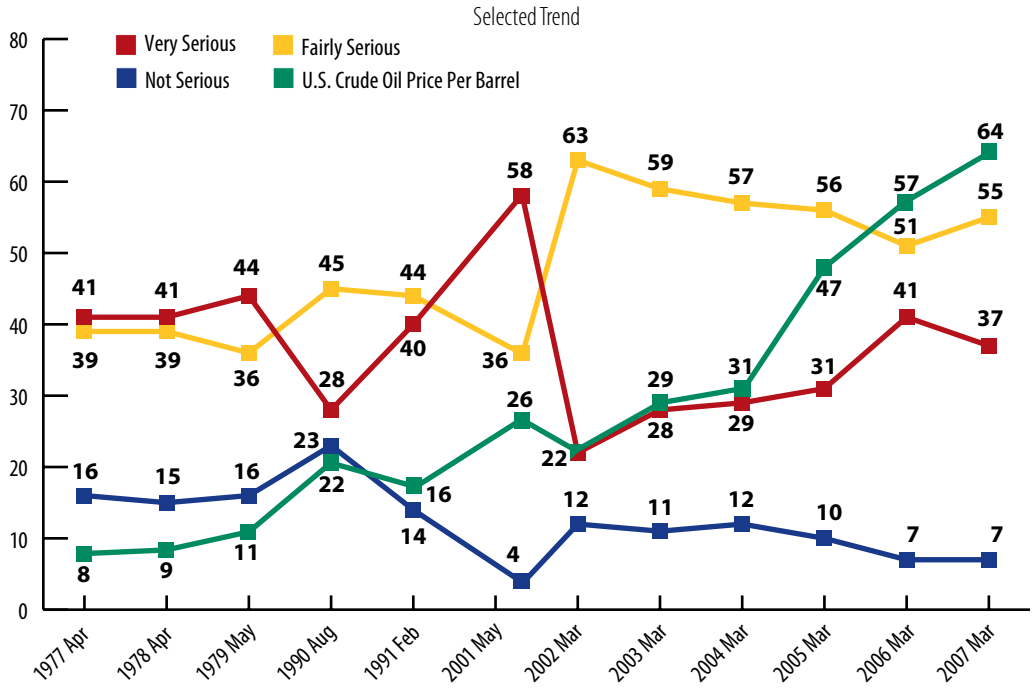
CNAS identified four key barriers to progress: public opinion, politics, international factors, and economics. Four authors designed strategies for overcoming each of these barriers: Josh Busby of the University of Texas (Austin) focused on the political barrier; Christine L. Matthews of Bellwether Consulting on the public opinion

barriers; Amy Myers Jaffe of Rice University on the international barrier; and Jason Furman of the Brookings Institution on the economic barrier. Their proposals are included in this volume and were vetted by the Solarium process.

The next American president will have to meet the energy challenge head on and turn these barriers into opportunities for new jobs, new growth, and new American leadership in the world. That will not be easy: the next American president will also have to figure out how to deal with Iraq and Iran, how to defeat al Qaeda and other violent extremist groups, how to restore the economy, how to improve health care in America, how to fund the retirement of the baby boom generation, and a number of other historic, pressing priorities. For the near and long-term security and prosperity of the nation, however, energy must be at the top of this list of priorities, even if oil prices decline somewhat in the coming months and years. This is, after all, a war, and if we stop fighting it, the foe will not run away.

To achieve a victory against the gas pump and the power plant, the next president needs more than the usual shotgun spray of policies; there must be a comprehensive strategy to deal with supply security and climate change simultaneously. This chapter outlines one possible approach to such a strategy. As with all "real" strategies it identifies the changes we need to bring about, while zeroing in on where we can have our greatest impact through a strategic goal, the ways to achieve it, and then a plan for how to get past the barriers and implement the strategy.

HOW SERIOUS WOULD YOU SAY THE ENERGY SITUATION IS IN THE UNITED STATES?



SOURCE: GALLUP POLL (MARCH 2007). OIL PRICE DATA FROM THE ENERGY INFORMATION ADMINISTRATION, "U.S. CRUDE OIL WELLHEAD ACQUISITION PRICE BY FIRST PURCHASES (DOLLARS PER BARREL)," AT HTTP://TONTO.EIA.DOE.GOV/DNAV/PET/HIST/F000000__3M.HTM.

The Strategy: The 70-40 Strategy

The bottom line when it comes to energy security is that the status quo is not sustainable and something needs to change. The sooner Americans accept that fact and understand the magnitude of the challenge and the urgency to meeting it, the sooner we will engage the considerable ingenuity and dynamism of the American people in finding a solution. Recent polls finding that the public sees oil dependency as the number one threat suggest that many Americans are ready for change. Given that the public has a history of losing that sense of urgency if the price of oil declines, however, it is very important that political and thought leaders define energy as a national security issue, and one that continues to endanger our safety and potentially offer opportunities—regardless of the price of oil.

Success in this energy security strategy would protect our way of life and secure the future from environmental, economic, and geopolitical threats associated with the use of fossil fuels. That will require weaning the American economy off of its carbon-emitting fossil fuel dependence, and ensuring that success can be repeated around the world with minimum possible lag time. With current technologies, this is not possible, and indeed, the U.S. economy will continue to use fossil fuels for the foreseeable future. The goal today, therefore, should be to reduce that dependency dramatically. Current legislation before Congress[7] calls for a reduction of greenhouse gas emissions of 70 percent in about 40 years, a 70-40 strategy. Because such a large portion of the climate-changing emissions humans generate comes from the energy we use and how we use it, taking on the emission goal by definition means changing our consumption of oil and coal. We estimate that a 40-year timeframe for achieving such a goal is reasonable—indeed, that is about the length of time it took containment to succeed in the Cold War—though the United States will have to make important gains early on and in the transportation sector (the legislation in Congress differs on these two points)[8] if the world is to avoid the worst effects of global climate change. This may seem to be an optimistic target, but the point of a strategy is to define what success looks like and then chart a path for reaching it.

Broadly speaking, there are two paths the United States can follow to a 70-40 strategy: change the supply (the fuels we consume) or change the demand (the way we consume those fuels). Change on this scale will require wise, consistent government policy, American global leadership, and a great deal of buy in and support from the private sector and the public.

> *"More than three decades after the 1973 oil crisis, the U.S. supply of oil is no more secure than it was thirty years ago."*
> *—Amy Myers Jaffe*

Change the Supply of Fuels. Right now, oil is king—nothing else packs the energy punch per volume, which is particularly important for transportation.[9] While coal has a lower energy content than oil by volume, it is far more prevalent in the United States and some of the world's largest and fastest growing economies. There are certainly alternatives to oil and coal, including natural gas, nuclear power, biofuels, solar, wind, hydrogen, methanol, wind, and ocean tides, but none of these fuel sources can yield sufficient supply in the immediate future to replace oil and coal in the United States or around the world. In most cases, further exploration, either in the laboratory or in

the field, will be necessary to even know if it is possible to expand the percentage of the energy mix these sources supply. Of course, there may also be major breakthroughs yet to occur.

The most important thing America can do, therefore, is to invest in the search for fuel sources that can be lasting, economically feasible substitutes for oil and coal. Given the scope of the challenge, it is striking that in real terms U.S. governmental investment in energy research and development has been declining significantly since the 1970s, from a high of about $6 billion to about $1.4 billion today.[10] For comparison, during its five years, the Manhattan Project that produced the first nuclear weapons cost about $22 billion in today's dollars.[11] The government also spent about $18 billion per year on the Apollo project to send Americans to the moon.[12] Out of a total Gross Domestic Product of over $13 trillion last year,[13] increasing governmental investment by a factor of as much as ten would be a drop in the bucket for the American economy.

There is one innovation challenge that will be instrumental in changing the fuel supply. The reality is that until there is a major discovery of to-scale, affordable alternatives, several of the world's largest economies are going to keep using coal for some time to come. China and India are under pressure to maintain high growth rates and lift hundreds of millions more people out of poverty, and they will certainly continue to use coal-fired power plants to fuel this growth—it is estimated that China constructs two 500 megawatt coal-fired plants every week.[14] For that matter, the United States currently gets 50 percent of its electricity from coal and has an estimated 491 billion short tons of domestic coal reserves.[15] There is an urgent need for better, cleaner technologies for burning coal. Although there are several projects around the world now using technologies that capture carbon emissions and then store or sequester them,[16] this technology has not been demonstrated to scale in all its phases. Major innovation, including demonstration projects, is needed to bring down the cost and broaden the applicability of carbon capture and storage.[17]

There is no question that the United States must invest far more resources in research and development, but it is essential that government standards, regulations, practices, and programs meant to promote innovation be sensible and consistent or they may deter private investment. The U.S. government's track record in this area is unfortunately not sterling, as the National Petroleum Council points out: "Technological and policy efforts to meet energy-security and environmental goals are sometimes aligned, but often are not."[18]

The fact is, however, that until there are major breakthroughs, none of the technologies or energy supplies available today or in development will be a silver bullet—not hydrogen, not carbon sequestration, and certainly not corn ethanol. Until our investment in R&D pays off, diversity will be an important bridge.

The Pulitzer Prize winning author, Daniel Yergin, has pointed out that "since Churchill's day, the key to energy security has been diversification."[19] In this strategic sense, diversification refers to maintaining a varied energy portfolio—of energy suppliers, energy inputs, technology paths, and infrastructure.

The logic behind diversification is that reliance on any one source of energy is a vulnerability, whether to deliberate attack, manipulative policies, natural disaster, unanticipated shortages, or other chokepoints. Nonetheless, the United States has tended to rely on single technology paths, which has led to the status quo dependence on oil for transport.

A similar principle applies to the suppliers of energy, particularly oil, since the United States gets most of its other energy from domestic sources. The more the United States and other major

consumers can diversify their sources of supply, the less vulnerable they are to accidental or deliberate disruptions from a single supplier. Although diversifying oil suppliers may seem to run counter to the goal of this strategy, the fact is that the United States will continue to use a signficiant quantity of oil for some time to come, even if this strategy were to succeed. The United States must limit its oil supply vulnerability as much as possible by diversifying its suppliers as much as possible.

A related method of diversification is to increase domestic energy supplies other than coal and oil.[20] This would benefit the domestic economy, including by shrinking the trade deficit (oil accounts for 40 percent of the current deficit).[21] The U.S. government would also have more information and likely more control over supply, relative to supply from other sovereign nations, and therefore be able to better manage crises and disruptions.

The debate about U.S. energy policy usually bogs down in this area, however. There are sharp and often sharply partisan differences about which forms of domestic energy to expand (such as renewables versus increased drilling for oil versus nuclear), as well as differences from state to state. Twenty-three states produce coal,[22] for example, 14 of them at significant levels. Despite the temptation to adjudicate the tradeoffs, we think this is a red herring: the truth is that in order to meet the scope and scale of current and growing energy demand, the United States may well have to allow the private sector to expand all feasible domestic energy resources. Government policy should, by all means, stop subsidizing negative externalities (i.e., by defraying the security, health, and environmental costs of oil and coal), consider second-order effects (e.g., the impact of increasing corn-based fuels on global food supply and prices), and do a better job of using policy tools to incorporate the positive effects of some alternative fuels, such as solar power.

This may well mean increased and improved drilling for natural gas, siting of new nuclear plants, new coal plants with carbon capture and retrofitting old ones, an increase in wind turbines, new solar generating plants, and biofuels. A maximal policy is the best chance at success in making it through this transitional period while maintaining economic growth. That does not mean anything goes: we must include the long-term costs of carbon emissions and climate effects in developing an energy strategy , particularly if we are to succeed in promoting the growth of viable long-term alternatives.

Change the Demand for Fuels. The simplest change the United States could make on the demand side of the energy equation would be to just use less fuel in the first place. Indeed, it would be difficult to overstate the importance of conservation, a source of energy supply in its own right that is economically and environmentally sound and entails no security risks. This is less a question of Americans turning down the thermostat, though that would help, than it is a matter of technical fixes. The McKinsey Global Institute estimates, for example, that the United States could displace the equivalent of 11 million barrels of oil per day and reduce greenhouse gas emissions by 1.3 tones per year just by using existing, more efficient technologies.[23] Many private businesses are already making significant investments in energy efficiency, but far more significant gains are possible. In many cases, there are process or technological fixes, such as embedded smart technologies or more fuel efficient engines, but there are other ways to dampen demand and improve the energy intensity of our economy, including better regional planning and mass transit.

Another way to change fuel demand is to speed the development of electric or hybrid electric vehicles. Again, this is fundamentally an innovation challenge, one that requires a larger and more consistent

investment in research, development, and in this case, commercialization of new technologies. With oil prices as high as they are right now, the market is taking care of this to a large extent. Additional government support could help shorten the timeline, however, and will be crucial if oil prices should fall. Even if the United States makes a dramatic shift to electric cars in the next forty years, if the costs do not come down enough to compete with the internal combustion engine, global oil use for transportation will continue to rise.

"Making firms and consumers face the social costs of carbon emissions and oil use is the single most important tool for mitigating climate change and promoting energy security."
— Jason Furman

Finally, the way the world uses fuel right now literally constitutes a vulnerability in the sense that the physical systems for supplying energy are insecure. The evidence is clear, from the 2006 terrorist attacks on the Saudi Arabian oil production and export infrastructure at the Abqaiq facilities, to the regular attacks on Iraq's energy infrastructure, to the 2003 electricity blackout covering much of the U.S. Northeast up into Canada, to the 2007 harassment of a U.S. navy ship in the Persian Gulf by small Iranian patrol boats.

The many ways to address this massive susceptibility to natural disasters, attacks, and the ravages of decrepitude involve both foreign and domestic policies. The United States needs to work harder to cooperate with international partners to harden these targets, with particular focus on the most vulnerable sections of the supply chain, namely chokepoints for sea-based transport and pipelines. Policy makers also need to consider such vulnerability in all decisions regarding energy. For example, the United States must take into account the attractiveness of Liquefied Natural Gas (LNG) terminals as terrorist targets when making decisions about increasing imports and siting these structures. Finally, the U.S. electricity generation and energy distribution systems are aging, and as infrastructure is replaced, vulnerability must be a key factor in modernization decisions. Note that replacing these systems also provides an opportunity to improve efficiency; today, about two-thirds of energy is lost in the process of converting it for human use.[24]

Toward An Implementation Plan: How To Keep Energy Security A Top Priority

To date, the United States has made marginal changes in our energy supply and demand, and these changes have been very hard fought. Adopting a comprehensive strategy will be difficult given the barriers to adoption, the most significant of which are the U.S. political system, public opinion, international considerations, and market conditions. These barriers are not insurmountable. The authors who follow address each of these challenges in detail, and this section offers possible implementation strategies for each.

TURNING THE POLITICAL BARRIER INTO AN OPPORTUNITY: CREATE NEW POLITICAL MOMENTUM AND LEADERSHIP.

Entrenched industries, established relationships, special interests, and very strong political divisions heavily influence energy policy decisions today, creating a barrier to significant change. First, there is the divide between the executive and legislative

branches of the federal government, which enjoy very different capabilities in this area. Congress, driven by local constituencies and industrial and interest groups and ruled by compromise, has great difficulty promoting systemic changes in energy policy. The coal and oil industries provide thousands of jobs in many states, for example, and none in others; representatives of these states will naturally have different energy goals and voting records. And while the incumbent president has used the bully pulpit to change the nation's frame of reference about oil, he has pursued a largely status quo energy policy, particularly when it comes to climate change. Second, there is a sharp partisan divide, with Republicans talking about dependence on foreign oil and Democrats talking about the risks of climate change. Third, political leaders do not always have access to the full range of information they need to make informed choices. Finally, what progress has occurred has not been coordinated: in the absence of federal leadership, states and localities and the private sector have been taking action of their own. At least 28 states now have Renewable Portfolio Standards, for example,[25] which commits them to getting a certain percent of the state's energy from renewable sources. Eight-hundred and fifty-two cities are part of the U.S. Conference of Mayors Climate Protection Agreement, which involves pledging to meet emissions standards set by the Kyoto Protocol and pressuring other government officials to take action on climate change.

An additional problem is that the organizational structure of both the executive and legislative branches lends itself to gridlock on energy security, with a multitude of committees, subcommittees, seniorities, agencies, and offices that have some jurisdiction over energy. And governance itself can be a significant challenge, given that it can be very difficult for congressional staff and federal bureaucrats to effectively pick winners and losers in the energy sector.

"While both Democrats and Republicans favor policy reform in the energy arena, they may have very different ideas of what constitutes reform. Where Republicans tend to favor lifting environmental restrictions on domestic exploration of oil and gas resources and nuclear power, Democrats tend to favor alternative energy sources."
—Josh Busby

All these factors combine into a formidable barrier to change, but one that can be overcome. The following measures will help create the political consensus an energy security strategy requires:

Engage presidential leadership. Because it is by nature divided, Congress is not going to be the policy leader in crafting or executing an energy strategy, though it has an important supporting role to play. Presidential leadership will be essential. How to engage this leadership is easy to spell out, though it will be difficult for the next president to do in the face of competing priorities. The

next president must make a strong rhetorical case for energy security, lay out a comprehensive strategy, and then sustain his personal, political, and institutional attention to executing that strategy (institutional in the sense that the Office of the President and its immediate support functions need to have personnel devoted to advancing this issue). As Josh Busby points out, the next president will have a passing moment of opportunity to suggest a significant and sweeping change; he or she has to take this action right away. The United States will not have national change until it has national leadership—there is simply no substitute.

Tap ground-up political pressure. Even though national leadership is crucial on this issue, the ground-up political pressure coming from the states, localities, and the private sector is an important factor and also can serve as a policy incubator for federal-level proposals. Organizations such as the National Governors Association should step up efforts to use their lobbying power to press the federal government to help, rather than hinder, energy policies. Finally, in order for an energy strategy to be successful, it will have to focus on how to grow new jobs and industries in regions of the country that will otherwise lose out in the economic transition that a more coherent energy policy requires.

CASE STUDY: **FLORIDA**

Florida holds great potential for pushing grassroots pressure up to the federal level to influence Congressional Republicans, and possibly a current or future Republican president, on energy security and climate change. Republican Governor Charlie Crist, in office since January 2007, has made energy and the environment top concerns for his administration, and he has proposed and enacted sweeping changes. In May 2008, the majority Republican Florida state legislature passed an energy bill from Governor Crist that includes a state greenhouse gases cap and trade system and incentives for renewable energy. Though some environmentalists consider it a mixed bag with its inclusion of biofuels and nuclear promotion, Governor Crist declared of it, "We've finally moved Florida and the Southeast to the forefront on climate change."[26] While the Governor's statement is not borne out in fact (the Southeast lags most of the rest of the country in climate change and energy policies), his optimism is certainly laudable. In another unique example of states taking the lead on research, development, and implementation, Republican Congressman Dave Weldon pushed to create the Florida Hydrogen Initiative with support of both Governor Crist and Republican former Governor Jeb Bush, and the state has several hydrogen buses and fueling stations.

The state's federal representation seems mostly in line with the patterns of state-level progress. In 2007, the most important energy package that Congress has passed in years, HR6, won the votes of 11 of Florida's 16 Republican representatives and 7 of its 9 Democrats (two did not vote).[27] A look at Florida's Senators—one from each party—shows a more mixed record on recent key energy security and climate change votes.[28] It is clear that all the ingredients are present for this state's Republicans to coalesce to create the momentum needed for their party to begin taking more ownership of these issues at the federal level, and particularly with its swing-state status in presidential races, to influence the next president.

Figure 1

STATES LEADING THE WAY ON INNOVATIVE ENERGY SECURITY AND CLIMATE CHANGE POLICIES		
At the Forefront	In the Middle	Not Doing So
California	Arizona	Alabama
Connecticut	Arkansas	Alaska
Delaware	Colorado	Georgia
Florida	Indiana	Idaho
Hawaii	Iowa	Kansas
Illinois	Michigan	Kentucky
Maine	Minnesota	Louisiana
Maryland	Missouri	Mississippi
Massachusetts	Montana	Nebraska
New Jersey	Nevada	North Carolina
New Mexico	New Hampshire	North Dakota
New York	Ohio	Oklahoma
Rhode Island	Oregon	South Carolina
Vermont	Pennsylvania	Tennessee
Washington	South Dakota	Texas
Wisconsin	Virginia	Utah
	West Virginia	Wyoming

Based on analysis of voting, legislative, and gubernatorial patterns by Josh Busby and CNAS authors.

For example, it will be very difficult to convince coal-mining states to stop obstructing better energy policy until they have a vested interest in the change.

Create bipartisan consensus. After the next election, the U.S. Congress may remain closely divided. If the country is to adopt a comprehensive energy security strategy, therefore, it will be necessary to bring members of both political parties on board. More broadly, political leaders will only get so far ahead of public opinion, and changing public attitudes will require appealing to a cross-section of society. That means defining energy security in terms both parties can accept, and more to the point, it means that Republicans must adopt climate change as their own issue. This is particularly true in the Senate, which has a high vote threshold for treaty ratification, and which may well be

asked to ratify a new international climate change treaty in the next four years. Engaging Republicans requires that: 1) Energy policy be redefined as a national security matter; 2) Democrats adopt this more inclusive definition, particularly if the next president is a Democrat; and 3) Selected, key Republicans be cultivated with information and dialogue. Key "energy swing states," many of them Republican-leaning, include Ohio, Pennsylvania, Michigan, Iowa, Indiana, Minnesota, Missouri, South Dakota, Arizona, Colorado, Oregon, and New Hampshire. Broadening and deepening the political constituency for an energy security strategy, particularly in these states, will be crucial to its success.

Improve information. A significant challenge in reaching out to members of Congress is that the communities of interest are fragmented, and there is a corresponding fragmentation of information. Political leaders may be forming positions and opinions in the absence of clear information, with no way to know who is right and who is wrong and which information is reliable. Although the Department of Energy plays a coordinating function to some extent, there is really no honest broker to adjudicate among these communities, collate information, and build a complete picture of the threat environment or the range of responses. In such circumstances, it is very difficult to make sound decisions about tradeoffs, within energy policy and between energy and other national priorities, such as health care. It is important to find honest brokers and collaboration hubs that can convey solid, credible information to policymakers and opinion shapers and back to the public. Although resources to plug some information gaps will have to continue to come from the executive branch of government, other groups can certainly conduct public opinion polls, focus groups, informational events, and other data-gathering and communication efforts.

TURNING THE PUBLIC OPINION BARRIER INTO AN OPPORTUNITY: HARNESS THE PUBLIC VOICE.

Today, public opinion forms a barrier to action on energy security in several ways. First, the public creates demand pull and market signals that the private sector relies on, for example in car company decisions to produce more compact cars or more trucks. But the American public is not a monolith: divisions are often split evenly so that trends are not clear, and other times the range of views on energy and climate change issues is so large that no prevalent opinion can be distinguished. Changes in public opinion can be difficult to read and easy to misread.

Public opinion also goes hand in hand with the political barrier: the American people, after all, are the constituents the politicians answer to. On energy issues, the voice of the public is often drowned out by those of special interest groups, however—until and if overwhelming majorities of the public coalesce around a position. Although it has been changing in recent years, public opinion has not aligned to push for change in this way.

A top concern for the American public at the moment is the price of gasoline,[29] which has repeatedly hit record highs in the first half of 2008. In general, in excess of 90 percent of the American public believes that our energy situation is serious or very serious.

Public opinion on this subject is very complex, however. Americans understand there is a problem but do not necessarily understand the nature of the problem or see themselves as part of the solution. In a May 2007 Gallup Poll, respondents were asked an open-ended question about what they thought was causing the hike in gasoline prices. The number one answer by almost 20 points was "Oil/gas companies getting greedy and gouging the public."[30] When the same poll asked respondents what they were willing to do to save gasoline, most of those polled said they would cut other discretionary spending in order to pay higher

gas prices rather than make any changes in their fuel consumption, such as carpooling or taking mass transit.

Changes to the energy supply and delivery composition are also dogged by the "not in my back yard" mindset. Citizens often desire the benefits of increased energy capacity or clean technology, but not enough to want the infrastructure near their property or drilling and refining in pristine public spaces. This will likely be a continuing hurdle in increasing and diversifying domestic energy supply sources. Still, there are also numerous opportunities for cultivating the public's understanding of this threat and desire for change. There are a number of ways to mobilize public opinion in support of a new energy security strategy:

Redefine the message. Just as with the political debate about energy, the public tends to split along partisan and regional lines. Republican voters, particularly in the South and in the Great Plains states tend to think of energy security in terms of dependence on foreign oil. Democrats, particularly in the Northeast and on the West Coast, are concerned about oil dependence, too, but focus more on environmental issues, especially climate change.[31] To best capture all of these constituencies, the link between oil supply security and climate security needs to be made clear: the public needs to hear a clear case about why these two sets of challenges are linked. There is an important opportunity to use the sense of urgency different groups of Americans feel about aspects of this issue to focus their attention and understanding on the broader challenge and develop a common understanding.

Broaden the energy security constituency. Different messages about energy security appeal to different American audiences, but framing energy policy (and especially climate change) as a national security issue appeals to the largest number of people.[32] This is also an appropriate way to frame the issue: it is not a traditional national security issue, to be sure, in the sense that there is no agency in this threat — there is no Nikita Kruschev with his finger on the button. Nonetheless, the dangers for our safety and prosperity in our current energy dependencies are every bit as real. This framework helps people better understand what is at stake. At the same time, it is important to make sure that

"Policies that improve access to information on energy consumption may help firms and consumers find the most cost-effective abatement methods. Given information asymmetry in the electricity market, for example, requiring utilities to provide energy rate schedules, energy consumption calculators, or smart meters may increase consumer access to information and thus help consumers reduce emissions cost effectively."
— Jason Furman

the message holds out some hope and some concrete steps individuals can take; the public has to see that change for the better is possible, and that they have a role in that change.

It is also important to reach out to and incorporate new energy security constituencies, especially among Republican voters, if the political dynamic is to change. Some evangelical Christian groups are embracing activism on climate change, for example, as part of "creation care," so a morality framework can help in outreach to those groups. Sportsmen and women, many of them conservatives, are amenable to environmental messaging.[33] There is evidence that many different constituencies respond well to appeals based in the opportunities for new industries and jobs.[34] In general, Americans of all stripes respond to messaging that concerns local public health. There is a strong need for policy makers, opinion shapers, and interest groups to carry a message on energy security with the broadest possible appeal—a unifying national security framework with stewardship, conservation, opportunity, and protection woven in.

Improve transparency and invest in energy literacy. Right now, the American public gets a great deal of information about energy security and climate change, but some of it is not very good and some of it is just confusing. In part, this has to do with a lack of transparency and clarity about energy supplies; in part it has to do with the levels of uncertainty involved in scientific knowledge and ineffective communication of it; and in part, it has to do with deliberate misinformation campaigns.[35] One result is that some Americans put their faith in bad concepts—such as energy independence, a vague term describing an unachievable goal—or they feel indifference, a sense of futility, or just disbelief.[36]

Redefining the message to one of energy security and concrete positive opportunities for change will help, as will targeting new and broader audiences with a variety of print, electronic, and visual media—to include consumer information in utility bills and labeling on products (such as the Energy Star program). Another important tool is to recruit new messengers, particularly those who can pull together the fragmented communities of interest and create collaboration. Republican governors, for example, will be important in conveying good information that can unite politically moderate and conservative constituencies with Democratic constituencies. The most respected institution in America today and for decades now is the U.S. military, and so sitting and former military officers are important messengers as well. Indeed, an April 2007 report by the CNA Corporation, endorsed by 11 retired flag-rank military officers, was an important step forward in changing how Americans view climate change.[37]

The next president of the United States should be mindful of appropriate lessons from history. One way the U.S. government brought the Cold War home to Americans was through the Federal Civil Defense Administration, which started operations in 1951. This organization instilled both fear and a sense of empowerment in Americans through an effective information campaign with posters, films, and radio ads, encouraging Americans to practice "drop drills" and build backyard bomb shelters. Of course, this information campaign also had a downside risk: Senator Joseph McCarthy was able to harness public fear in a highly destructive political vendetta. Another less problematic public information campaign has involved cigarette smoking, which instigated a dramatic decrease in the proportion of American adults smokers (see text box). It will be important to have a credible, broadly acceptable messenger who can make a definitive statement about the nature of energy

CASE STUDY: **CHANGING PUBLIC BEHAVIOR:** ***Adult Cigarette Smoking in the United States***

In 1964, more than 42 percent of the adult U.S. population smoked cigarettes. Today, about 21 percent of the adult population smokes. This decline is a direct result of a 40-year effort to change public attitudes and public behavior through information, taxation, and regulation.

Although there had been numerous studies and statements about the potential health risks of smoking,[38] 1964 marks the start of the modern campaign against it. In that year, U.S. Surgeon General Luther Terry, a trusted, highly credible source of information, released a definitive statement that cigarette smoking presented a health risk, confirming direct links to fatal and chronic diseases.

The resulting campaign against smoking was comprehensive and effective, but it was not orchestrated. Instead, the Surgeon General's announcement had a snowball effect, with every sector of society gradually engaging in a national, state, and local campaign.

This mix of actors has used a variety of tools to discourage smoking Front and center has been an information campaign, engaged in by federal and state governments, private companies, and nongovernmental organizations. Tactics have ranged from suppressing misinformation about smoking, such as federal and state bans on advertising for cigarettes, to directly reaching all cigarette consumers with warning labels, to the publication of numerous scientific studies. Regulations, such as public bans on smoking, have become increasingly prevalent over the past decade.[39] Finally, the direct taxes on cigarettes at both the federal (39¢ per pack) and state level (varies from 7¢ to $2.58 per pack) have had a particularly direct effect on demand. A study recently published in the *American Journal of Public Health* found that doubling the price of a pack of cigarettes would result in a 5.9%–9.7% decrease in the number of smokers.[40]

Even though the anti-smoking campaign has been successful at changing public attitudes and public behavior, it was apparently easier to convince people to start smoking than it was to convince them to stop smoking. The sharp rise of cigarettes, after all, was really a post-World War II phenomenon: per capita cigarette consumption in 1940 was about 2,000, a number that had more than doubled by the time of the Surgeon General's announcement. It only took 20 years to hook the American public, and it took 40 years to get back to the 1940 level of consumption. Even when an individual's life is at stake, behavior is hard to change: 45 million American adults still smoke today.[41]

security, as the Surgeon General did in the case of smoking, in order to improve the knowledge base of the American public, catalyze a broad coalition that can function as a counterweight to today's sclerotic system of vested interests, and launch a broad-based campaign with a hopeful message of efficacy. It will undermine the effort if the individual who takes on this role is a divisive or partisan figure, something the next U.S. president should take into account.

A great danger right now is that the price of oil will fall, and with it, any sense of public or political urgency. Even if the price of oil is lower, however, that does not defray the national security risks of our current dependencies on fossil fuels, particularly oil and coal. Moreover, any fall in price will be temporary (remember that oil was $10 a barrel a decade ago, and is now $120 a barrel). That is why it must be a high national priority to make sure the American public understands the national security implications of oil dependency. At the same time,

"Perhaps the most important strategy for changing hearts and minds on these issues is to proceed with humility: there are high stakes and probably high costs involved, and difficult tradeoffs to be made, and people do understand that."
—Christine L. Matthews

individual Americans cannot be passive bystanders in this process; the public has to become activated and actually make changes in behavior to have any effect at all on the country's energy security. There is evidence that many Americans are, indeed, willing to embrace such changes.[42]

TURNING THE INTERNATIONAL BARRIER INTO AN OPPORTUNITY: PRACTICE ENERGY DIPLOMACY.

Considering the significant vulnerability caused by the U.S. dependence on foreign oil sources, it might seem that the clearest answer is "energy independence," or only consuming what we can produce at home. While using more domestic sources is generally a wise idea, it is unfortunately not enough and not feasible at this time. Energy security is inherently a problem the nation cannot solve on its own, nor is it a problem unique to any nation.

Oil, for example, is priced in a global marketplace, so even if the United States used more domestic supplies of petroleum, this would not insulate the U.S. economy from price shocks. With the advent of LNG, the natural gas market is heading in a similar direction. Furthermore, many of the major threats to supplies transcend borders, such as sea lanes and pipelines. Climate change certainly knows no boundaries, and it will be one of the top environmental and national security challenges the world faces for decades to come, particularly for the top emitters such as the United States and now China. As nations around the world struggle with how to maintain economic growth and cut carbon emissions, they may well turn to nuclear power. At least 40 developing countries already have indicated an intention to do so.[43] The United States has a vested interest in making sure any growth in nuclear power does not lead to an increase in weapons proliferation and safety problems, not to mention that the U.S. nuclear industry has a commercial interest in capturing some of a global nuclear power market.

On the demand side, the booming economies of China and India will continue to increase their energy use dramatically, coupled with the relatively much higher per capita consumption in industrial nations, which will hold steady or increase slowly. As total global demand has spiked, supply levels have stagnated. Today there is little to no excess capacity in most oil exporting nations, and many national oil companies, of which ten are the world's top oil and natural gas reserve holders, have in effect decreased their available supplies through mismanagement and political turmoil. More than three-quarters of the world's remaining oil reserves are controlled by NOCs, presenting serious challenges of resource concentration.[44] This is yet another international trap to the energy the United States consumes, as producer nations have no requirements to react positively in times of tight supplies, and may have greater incentives to act harshly for political leverage or to cadge higher rents from consumers. When all these factors combine to push up prices, the United States on its own has scant ability to cushion Americans from the economic pain.

Energy security is inherently an international issue, and it will have to be treated as such by the next president. This barrier is highly interrelated with the others: changing the political and public opinion dynamics will be crucial to mobilizing U.S. leadership in international efforts to achieve energy security. Most initiatives for international action on energy and climate change, such as cooperation with China, would require popular and political support at home as a prerequisite, particularly for sustained engagement. Given that level of support, important measures would include:

Cooperate with other consumers, starting with China. An important step in turning the international situation to better favor U.S. interests is fostering cooperation among major oil consuming nations. In overcoming the international barrier to energy security, there is no reason that net energy consumers, sending billions abroad for oil, should completely dismiss any leverage that transfer of wealth might allow. For various reasons, the United States should look to China as a key partner in this effort. As two of the world's biggest energy consumers, China and the United States have the potential to affect oil prices, to balance "monopoly power" with "monopsony power."[45]

The two nations already have a robust and strategically vital relationship to serve as a foundation for cooperation. Indeed, regardless of climate change and energy security, shaping relations with China will be a top foreign policy priority for the next administration. Furthermore, the fate of international climate change negotiations may hinge on Sino-American relations, as each of these top greenhouse gas emitters are reluctant to act without action from the other.

The United States will need to approach China at a high diplomatic level about energy cooperation in order to succeed. Today, the two nations collaborate at technical and explorative levels, but there are limits to what can be accomplished in these discrete efforts. As Amy Myers Jaffe suggests, such exchanges should be conducted in the future by the vice president or a presidential appointee dedicated to energy-related diplomacy.

One often-suggested way to better coordinate with China to exercise consumer-nation power is to invite it to join the International Energy Agency (IEA), which would expand upon the ways in which it already coordinates with and briefs China on its members' activities. Formalizing this relationship would dramatically change the image that consuming nations portray to producers today, particularly that of the East-West split and competition for favored status with individual producer nations. The requirements for OECD membership can be waived, or perhaps China could be offered terms by which it could be admitted to the OECD. China, after all, met the requirements to join the WTO.

Once China and the United States begin to display consumer-nation cooperation and leverage, in supply issues but also in end-use technologies such as electric cars, it will be easier to launch cooperative efforts with other consumer nations. India and Brazil will be at the top of the list as growing energy consumers and top greenhouse gas emitters. The United States already shares largely constructive relations with each, and elevating energy to a higher priority would be a reasonable extension of existing relations.

Coordinate strategic stocks. One short-term method of consumer cooperation to increase energy security is through strategic petroleum reserves (SPRs). A nation's strategic reserves function as a cushion in the event of a serious supply shortage, as happened in 2005 after Hurricanes Katrina and Rita in the Gulf of Mexico. They can also reduce the motivation of producer nations to flex their muscles by cutting exports to specific nations, and they provide a security asset during times of war. The next president may have limited

room in increasing the U.S. SPR in the short term, as infrastructure has to be built and record-high crude prices make government oil purchases less attractive. However, China plans to dramatically expand its SPR in the coming years, and the United States and IEA coordinating strategic reserve policies with China would create a powerful consumer-nation hedge against market disruptions or manipulations.

Improve relations with producers. Cooperating more closely with consumers does not preclude cooperating with producers, as well. Placing energy security higher on the list of national priorities will help drive better diplomacy. One way to cooperate more directly with energy producers is to help promote efficiency of national oil companies, particularly the ones that export large amounts of energy to America. Among such nations, working with Mexico is perhaps most important. Oil production in Mexico, the third largest supplier of oil to the United States, has been in steep decline in recent years largely because of inefficiency and poor technical ability to recover oil from all of its deep-water reserves. Mexico's political stability is far better than that of other major suppliers, and there are close ties between America and Mexico, not to mention the value of proximity. The United States should do all it can, with great sensitivity for national pride, to help Mexico improve its oil production and raise its export earnings.

TURNING THE MARKET BARRIER INTO AN OPPORTUNITY: PRICE THE EXTERNALITIES.

The economic barrier that stands today in the way of energy security is the result of a series of market failures and distortions, many of which the United States has inflicted upon itself for decades. Billions of dollars in government subsidies to companies that produce or burn oil and coal have distorted the market to make these fuel sources seem cheap. They have ensured that the costs of externalities — military action in energy-producing regions, health care, and environmental degradation — are not included in the prices consumers pay directly for the energy they use. Further system failures stem from cartel and central control of oil and increasingly natural gas in Europe, which help to de-link supply, demand, and pricing.

Markets can and do adjust to align better with public desires, but there are times when government action is required, especially when it has a hand in causing the distortions. Federal government policy directs and can dramatically affect the market. If previous leaders have created a barrier to energy security with previous decisions, it is up to current leaders to make necessary changes. In this sense, the barriers are once again interrelated: market failures cannot be overcome without addressing the political and public opinion barriers first. Taking that into account, there are a number of ways the government might tackle the market barrier:

Put a price on carbon. Pricing carbon correctly is now widely accepted as the best way to alter the energy security situation, bring the cost of externalities to consumers, and affect demand for carbon-emitting fuels. Differences of opinion lie in how to actually impose that cost, with the sharpest divide between establishing a market-based carbon cap and trade system and charging a carbon tax. If implemented properly, either method would establish an effective carbon price, so the choice really comes down to which is most politically viable. Most recently, the U.S. Congress appears to favor a cap and trade system, but legislators will have to reassess the political landscape as they plan the timing of votes.

Eliminate counterproductive spending. While this will be politically difficult considering the vested interests involved, the government should try to cease spending money in ways that counter its own goals on energy security. Spending cuts on things that are counterproductive — namely

incentives for coal and oil use — could provide new revenue streams for productive measures. The Democratic majority in Congress has unsuccessfully attempted several times in the past few years to cut about $18 billion in tax breaks to big oil companies, for example, to pay for incentives for alternative energy production.[46] Another option could be to reduce any tax or fee benefits for private planes.[47]

Increase taxes — and flexibility. While gas taxes are highly unpopular with Americans — indeed, the political dialogue now focuses on removing, not increasing such taxes — they are a direct method of accounting for the indirect costs to society of consumption. Gas taxes also give the nation flexibility: oil is priced on an international market, and supply flows are global. Gasoline taxes allow for a method of relieving price pains in extreme times, such as with a major, long-term supply disruption. However, as with strategic reserves and other energy supply mechanisms, national leaders must be careful to use such devices for relief only at strategic times and for the highest-level reasons, such as if an oil exporting nation or group is using supply controls to pressure the United States — not in reaction to market-based effects such as steadily increasing prices resulting from natural supply or distribution issues.

Engage the American people. Public opinion consistently indicates that while individuals are willing to make some simple consumption adjustments, people believe that the onus should be on government or industry to fix the problems of climate change and energy security. It is in part a perception that individuals would have to choose to dramatically reduce their quality of life to have a major impact. Another factor is economic equality. Most Americans are concentrated at the middle and bottom of the income ladder, and therefore it may seem unfair to demand sacrifice from the public majority that often struggles to tread water — the main argument also put forward by developing nations. On the other hand, public opinion polling also indicates that Americans are willing to pay higher energy prices and in some circumstances even taxes if they know that the proceeds will directly fund R&D for alternatives or other long-term solutions. It is critical to tie any attempt to correct market distortions to the direct effect on the larger energy security challenge.

"A climate policy would create new jobs in new industries, but it would also destroy some jobs in older industries. Over the long run, the economy would adjust, but in the short run this transition could be disruptive to particular industries, such as coal mining, and particular geographic areas that are heavily dependent on these industries."
— Jason Furman

DEALING WITH THE BARRIER OF TIME: BE PREPARED FOR NEAR-TERM SHOCKS.

There is one final energy security barrier to take into account: time. To reach its long-term energy

security goals, the United States and the world will first have to travel through the near term. There is a very real possibility, perhaps even a near certainty, that there will be energy supply and price shocks in the coming few years, and that those shocks will affect our ability to adopt a long-term energy security strategy—unless we are prepared.

If there is a disruption of the world's oil supplies, the pressure to turn to the most available and affordable alternative will be overwhelming. For the United States, China, India, and some 47 other nations, according to the World Coal Institute,[47] coal will be the easiest substitute. Absent breakthroughs in carbon sequestration, that could have a devastating effect on the global climate, reversing what modest progress the world has made and may make in cutting greenhouse gases.

One of the most important ways to make sure short-term crisis response does not sacrifice the wellbeing of future generations is to include in the 70-40 strategy short-term response measures. In considering what those measures might be, it is worth drawing lessons from the most recent major U.S. energy disruption, the 2005 hurricanes that hit the Gulf of Mexico.

The single best thing the nation—and indeed the world—can do to decrease the potential harm of energy disruptions and crises and to lower the risk of turning to resources such as coal, however, is to begin immediately reducing dependence on oil.[56] Nonetheless, the next administration needs to have a comprehensive, flexible plan ready in advance of an energy crisis, given the very real risk that

CASE STUDY: HURRICANES KATRINA AND RITA AND THE SUPPLY SHOCKS

In the immediate aftermath of Hurricane Katrina, oil production in the Gulf of Mexico was reduced by just under 92 percent and natural gas production by about 83 percent.[49] As bad as this was, the damage to oil refining capacity was even worse: about a month and a half after Katrina hit and a few weeks after Hurricane Rita, all but about 10 percent of U.S. oil refining capacity was still offline,[50] and 15 natural gas processing plants remained inactive.[51]

President Bush and Energy Secretary Samuel Bodman announced quickly that the United States would release crude oil from the Strategic Petroleum Reserve (SPR),[52] the main short-term domestic tool for easing the effects of disruptions or crisis, and the president authorized the Department of Energy to determine a rate for drawdown from the SPR to compensate for the supply reduction. The U.S. government in total sold or loaned 20.8 million barrels of oil in response to Hurricanes Katrina and Rita,[53] and the Bush administration has since requested funding to increase capacity up to 1.5 billion barrels, from about 727 million barrels today.[54]

International actors also swiftly and successfully wielded available tools. Within a week of Hurricane Katrina, the International Energy Agency announced that its 26 other member nations would release from their own strategic reserves up to 2 million barrels of crude oil or refined products per day for 30 days, pursuant with the IEA's response plans for oil supply disruptions. Nearly half of what the IEA countries released was refined product that could flow quickly into the market.[55] About a month later, OPEC lifted production quotas, saying that each country could produce as much of its capacity as was demanded, but warned at the same time that prices might not be affected drastically since the most enduring issues were refining capacity and product transport issues.

such a disruption could happen before the United States is able to decrease its oil use. Factors to consider include:

A public relations and education strategy. This will help the American people understand the full response plan, their individual responsibilities to contribute, and the cost of a failure to properly respond. A range of requests the president can make to the public and industry on day one to conserve energy includes carpooling, walking/biking, taking public transportation, reduced speed limits, telecommuting, and conserving electricity. Indeed, any response plan for an energy crisis should offer as much predictability and transparency as possible without jeopardizing other national interests. The 2005 hurricanes showed that if the public understands that supplies will be limited and prices will remain high in the near-term, demand can drop on its own before federal mandates need to be implemented.

Cost-benefit analysis. An exploration of the costs and benefits of relaxing various regulations can aid decision making, such as suspending environmental regulations to allow the use of seasonal gasoline blends if available.

Contingency strategies, clear responsibilities, and coordination mechanisms. There should be clear delineation of responsibilities among government agencies, state and local governments, and businesses, along with a menu of coordination mechanisms and thorough response plans. These plans should include contingency strategies for handling a short disruption, a long disruption, different types of man-made and natural crises, and cases in which small disruptions compound into longer-term crises. In particular, this would have to include a regularly updated Department of Defense plan which accounts for ongoing combat operations and provides decision makers with a long-term outlook for how operations might be affected by energy supply strains. A clearer sense of roles, missions, and plans will help the president make choices about how to most effectively respond to a crisis without delay.

Emergency Policy Options. The president will need a backstop set of more heavy-handed policies for an extended or severe crisis, and a plan to clearly communicate to the public and businesses under what conditions such policies will be implemented. On the easy end, this could mean measures such as setting a lower national speed limit, subsidizing reduced-fare or no-fare public transportation, and raising gasoline taxes to ensure demand drops; and on the more extreme end, rationing and driving bans.

Conclusion

In a time when American soldiers, airmen, sailors, and Marines are fighting bravely in Afghanistan and Iraq, it may be difficult to see America's struggle with the power plant and the gas pump as a tangible threat to national security. The danger to the nation, however, is every bit as real as the danger from an enemy who wishes to do us harm.

Indeed, while the United States should do everything it can to avoid an oil supply or price crisis, such a crisis may offer an opportunity to catalyze change. The barriers to action outlined in this report will likely be easier to overcome as the nation experiences true energy insecurity firsthand, to a degree not seen since the 1970s.

To prepare for when that happens, and hopefully long before a crisis occurs, policy makers need to have a strategy in place, such as the 70-40 strategy discussed in this chapter. That strategy should be maximalist, to include efforts to change the fuel we use and the way that we use it. With this strategy, political leaders and opinion shapers will have to make a high national priority of ensuring that the American public understands oil dependence and climate change as national security challenges. The stakes are high; if we succeed in executing such a

strategy, our economy, security, and environment will be stronger today and in the future. It will be up to the next president to turn the barriers into opportunities and lead the nation to long-term energy security and through any crisis that might alter the path the nation is on. Indeed, all Americans should be prepared to travel down this path with the next president.

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CHAPTER II:
OVERCOMING POLITICAL BARRIERS TO REFORM IN ENERGY POLICY

By Josh Busby

A Strategy for American Power:
Energy, Climate, and National Security

OVERCOMING POLITICAL BARRIERS TO REFORM IN ENERGY POLICY

By Josh Busby

In 1993, the Clinton administration came to power with ambitious goals to support core constituencies in the Democratic Party, including environmentalists. Vice President Al Gore's book *Earth in the Balance* had just come out. In the book, Gore declared that "it ought to be possible to establish a coordinated global program to accomplish the strategic goal of completely eliminating the internal combustion engine over, say, a twenty-five year period."[1] Still fresh with optimism about its capability to move legislation through a Democratic-controlled Congress, the Clinton administration believed that taxes on the energy content of fuel seemed like an attractive way to provide revenue for deficit reduction but also support environmental goals.

In February 1993, the Clinton administration announced as part of its budget proposal that it would impose a Btu (British thermal unit) tax on the energy content of fuel. Designed to raise $71.4 billion over five years, the Btu tax soon became a lightning rod for criticism.[2] In the first proposal of the Btu tax, coal and natural gas were taxed at the same rate, even though coal is more polluting. This was a way to avoid incurring the wrath of West Virginia Senator Robert Byrd.[3] The Clinton administration made a tactical mistake by then modifying the plan in April 1993 to further appease coal interests.[4] Once this move had been made, other interests piled on in an effort to seek exemptions from the tax while the oil and gas industry opposed it outright.[5] At the end of May 1993, the House, then controlled by the Democrats, narrowly voted to support the Clinton budget, including the Btu tax, after much arm-twisting by the White House.[6] Even though the House voted in favor of the remnants of the Btu tax, influential Democratic senators like David Boren of Oklahoma and John Breaux of Louisiana vigorously opposed it. In June 1993, the plan became doomed in the Senate, and the Clinton administration withdrew the measure before a vote.[7]

Ultimately, the Btu tax was replaced with a modest 4.9 cents per gallon gasoline tax. After all was said and done, the Btu tax effort proved to be a bruising legislative fight, and the gas tax was a largely inconsequential incentive for fuel efficiency or conservation. Indeed, one of the main outcomes of the Btu fight was the Republicans were handed a wedge issue in the 1994 midterm elections in which House Democrats who had voted in favor of the Btu tax were targeted for defeat. The failure to pass the Btu tax had a lasting impact on the White House's enthusiasm for domestic measures that would directly affect energy prices, especially gasoline. An energy tax, favored by environmentalists, became the proverbial political "third rail." [8]

The Btu tax episode is illustrative of how the nature of the U.S. system makes it very difficult to achieve more comprehensive and coherent reform in energy policy. It is but one of many examples this country has seen over the past 25 years where interest groups across the political spectrum have mobilized to defeat far-reaching energy policy measures.

This paper has two primary purposes. First, it explains how the U.S. political system structurally maximizes the ability for groups to block policy change. Second, the paper seeks to identify strategies to overcome those barriers in the interests of furthering the goals of CNAS' energy strategy including environmentally sustainable, geopolitically reliable, and physically secure sources of energy.

In **part I** of this paper, I provide a sketch of how policy is made in the United States and how our system has multiple gatekeepers empowered to block power change. This structural feature maximizes the potential power of interest groups to effectively veto policies they dislike. In that section, I provide some examples from recent history of how different groups with diverse agendas have capitalized on these structural features to stymie energy policy reform. In **part II**, I develop a strategy to overcome these political challenges looking ahead, with recent events in Congress suggesting the time is ripe for more comprehensive energy policy reform.

As I suggest in the paper, while both Democrats and Republicans are open to energy policy reform, they understand the problem differently. The explicit environmental component of the CNAS agenda makes it more attractive to Democrats, but the nature of the U.S. political system will demand significant Republican support in Congress. Much of this paper focuses on the geographic bases of political support for and opposition to energy and climate policy reforms ostensibly aligned with the CNAS agenda. Beyond the need for significant cross-party support, this paper highlights the importance of broadening the geographic basis of support beyond the East and West coasts, particularly in the Midwest and Rust Belt. In so doing, I draw attention to additional elements that will likely be important including presidential leadership, targeting messaging, and balancing the need for political viability and substantive progress.

PART I: Many Gatekeepers, Too Little Policy Change

Political institutions privilege some elites to have decision-making authority over different policy arenas. Some systems empower more actors than others and certain kinds of decisions may involve more players than others. For example, in a parliamentary system like the United Kingdom, a prime minister with a strong parliamentary majority can pursue their agenda without much legislative interference, particularly in the realm of budgets and treaties.

Elsewhere, I have described this kind of influence as the role of policy *gatekeepers*. [9] Gatekeepers are actors with sufficient power to block or at least delay policy change. From an

analytical perspective, when we think of energy policy reform, we have to ask, "who decides?" Gatekeepers analysis is based on work in political science called *veto players* theory.[10] Where there are many veto players, policy stasis becomes more likely.[11]

Different studies try to count the number of veto players in a given political system, focusing on *institutional* actors accorded influence under a country's constitution (this gets at the influence of the legislative and judicial branches) and *partisan* actors (this gets at the influence of political parties in divided or coalition governments). [12] Others also look to dispersion of authority, taking into account federal structures and the use of referenda.[13] When we look at the number of veto players in the U.S. system, we find that the United States possesses far more than other advanced industrialized countries, suggesting that the system of checks and balance in the United States usually will lead to more policy stasis than in other systems (see Appendix A). [14]

However, traditional measures may not be sufficiently fine-grained. First, there is some flux in the number of veto players. Until the 2006 elections brought the Democrats back to power in Congress, unified government likely reduced the number of veto players. More importantly, datasets of veto players do not capture actors with issue-specific blocking power, namely bureaucratic actors with delegated responsibility or legislative actors with committee oversight over spending, or societal actors with informal influence.[15] On energy policy, we would expect more of these kinds of gatekeepers based on functional delegation to congressional committees.

For international issues, especially in the security arena, we would expect fewer gatekeepers. For international affairs, the number of veto players is generally truncated so the judiciary or subnational units included in some datasets are not likely to be relevant. On issues related to national security, despite formal constitutional rules that specify a Congressional role in war powers, presidents have been able to exercise this authority with fewer legislative impediments than other policy domains. While national security policy has few gatekeepers, this does not extend to treaty ratification in the U.S. system, where a two-thirds Senate majority required for advice and consent increases the veto power of legislative gatekeepers. This helps explain why the Law of the Sea Treaty, supported by the Bush administration, the U.S. military, environmentalists, and the business community, and opposed only by fringe pro-sovereignty interests, has failed to secure final support in the Senate.

However, focusing on the number of gatekeepers in a particular policy area tells us only part of the story. We also have to know their policy views. If everyone is in favor of policy change in a system with many veto players then effectively there are fewer gatekeepers and a policy will go through relatively painlessly. If everyone is opposed, then the status quo is unlikely to change much either. Where you have a diversity of preferences and a large number of veto players, you also have a great possibility of policy stasis.

In the energy policy arena in the United States, you have highly fragmented societal policy preferences that play out in the preferences of members of Congress. Some regional economies are highly dependent upon production of certain kinds of energy (e.g. coal in West Virginia, petroleum in Alaska and the Gulf Coast), others on energy-intensive manufacturing (e.g. automobiles in Michigan, steel in Pennsylvania), others have highly mobilized environmental constituencies (e.g. in California, Pacific Northwest), some places are highly dispersed and require long driving distances (the West), and some economies are highly dependent on other products that may or may not play a role in future energy needs (such as biofuels

from the Midwest). There are also highly localized not-in-my-backyard (NIMBY) reactions to any facilities that will have a negative environmental or social footprint, such as drilling in the Arctic National Wildlife Refuge (ANWR), nuclear waste storage at Yucca Mountain, drilling off the coasts of Florida or California, or locating new wind turbines off of Martha's Vineyard. These attitudes, often taken up by local legislators (or in the case of the ANWR by distant ones) can impede the construction of new energy infrastructure, refineries, pipelines, nuclear power stations, wind turbines, and/or waste disposal sites.

Given the nature of energy policy, a sprawling set of committees have jurisdiction over some dimensions of the issue, giving different committee chairs the capability to block elements of policies they dislike. For example, on the House side, committees that have potential jurisdiction include Energy and Commerce, Science, Ways and Means, Transportation, and Agriculture, among others. On the Senate side, the proliferation of committees with jurisdiction is less extensive; the Senate Energy and Natural Resources is the lead committee with Finance taking on a role where tax breaks are involved.

This gives significant power to committee chairs who set the timetable for bills to be heard, if they are heard at all. A committee chair can seek jurisdiction over a piece of legislation only to scuttle it in committee. Because committee appointments have historically been allocated on the basis of seniority (or sometimes at the discretion of the House Speaker or the Senate Majority leader), committee chairs are often long-standing members who have sought that position to defend the parochial interests of their district. John Dingell, for example, is a Democrat from Michigan who chairs the House Energy and Commerce committee. He has made it his mission to blunt any energy policy that would have a negative impact on automotive interests in his district and state.

There are other structural impediments to policy change. The cloture rule requires that 60 members of the Senate vote to cut off debate; this allows a minority to filibuster and prevent a bill from coming to the floor for a vote. On December 7, 2007, a far-reaching energy reform measure got fifty-three votes, seven short of the sixty needed for cloture.[16]

In the context of energy policy reform, what we generally therefore see is intense mobilization by partisans against particular policies they dislike. Any challenge to coal interests is taken up by states heavily reliant on coal production. Any effort to increase fuel efficiency is challenged by automotive interests and legislators from Michigan. Provisions to drill in environmentally sensitive areas are challenged by states affected or, in the case of Alaska, environmentally-sensitized legislators from the continental United States. A piece in *Politico* described the challenge these cross-pressures create for Congressional leaders even in a single political party: "For Senate Majority Leader Harry Reid (D-Nev.), managing his own caucus is like playing with a Rubik's Cube, with each advance carefully calibrated to limit simultaneous losses."[17]

That means that major policy change in the energy arena is almost always defeated in Congress. On the margins, we see politically powerful interests logroll to get subsidies and incentives for their pet projects, leading to greater institutionalization of the status quo. This description of policy outcomes best captures the last "significant" energy policy reform of 2005 in which Congress failed to pass any significant improvement in vehicle fuel efficiency standards; maintained restrictions on drilling in environmentally sensitive areas, including the Arctic National Wildlife Refuge and the Great Lakes; provided a fuel mandate for ethanol; included modest subsidies for the purchase of hybrid automobiles, renewables, and investment in carbon capture; but largely left untouched traditional subsidies and tax incentives for fossil fuels.

At the same time, the failure of policy reform at the national level has contributed to local variation in state policies, with efforts by the Northeast and California to regulate carbon through regional emissions trading schemes. More than 20 states have renewable portfolio standards requiring that power generators in their states purchase a portion of energy from renewable sources. At the same time, states and interest groups have sought to push the margins of what is legally permissible activity, as California has done, by suing the federal government over the right to regulate carbon dioxide. These various legal efforts may also be seen as a way to goad the federal government into more comprehensive efforts through courts. For many analysts, this bottoms-up patchwork approach is a virtue, guaranteeing that no major transformation in energy and environmental policy will take place until a significant consensus has emerged at the state level.[18]

In the area of international commitments, we can see how the high bar for treaty ratification in the U.S. Senate enhances the power of interest groups on energy and environmental policy. For example, in 1997, after an intense lobbying campaign by the Global Climate Coalition—an industry-funded lobbying group—in the lead up to the Kyoto negotiations, the Senate passed the Byrd-Hagel amendment by a margin of 95-0, a nonbinding resolution that suggested the United States should not sign on to any climate treaty that did adverse harm to the U.S. economy or that failed to include major emerging emitters like India and China. The Clinton administration secured a treaty at Kyoto that possibly did both (or was perceived as such after an intense lobbying campaign by industry interests). President Clinton never submitted it to the Senate for advice and consent.

However, it was not just industry lobbying that created a context for failure. There has been growing support in the United States for a market-based cap-and-trade system, where greenhouse gas emissions would be capped and firms that needed additional permits could buy them from firms that found it inexpensive to reduce their emissions. This has been pioneered with much success for sulfur dioxide. However, a major problem has been the fear that the permit prices would become so expensive that sectors needing to buy them (such as coal-burning power plants) would find them exceedingly expensive. One idea that has been proposed to mute potential political opposition to a cap-and-trade scheme is the so-called safety valve.[19] The safety valve would commit the government to offer additional permits at a certain price if the market price of permits rose to be too high. Environmental groups have, for the most part, opposed the safety valve, for fear that the permit price would be too low to induce innovation by industrial interests. Environmentalists fear it would be cheaper for firms to buy permits than change their behavior. This, of course, all depends on the safety valve price being very low.

However, the opposition to the safety valve may be part of the reason why it has taken so long for the United States to enact a carbon constraint. Not discounting the organized and shrill opposition of much of the fossil fuel industry to any sort of carbon constraint, the counterfactual we have to ask ourselves is, "Would it have been possible to enact a carbon constraint with a safety valve that would have put us farther along towards significant greenhouse gas emissions reductions?"[20]

A related problem has been that environmental groups, despite limited overall influence on environmental and climate policy, have largely defined what it means to be pro-green or pro-environment on climate and energy policy. In the climate arena, this has meant a commitment to binding emissions reductions and short-term targets and timetables. In the context of the Kyoto negotiations, this put pressure on politicians, who wanted to appear to be green to satisfy core constituencies, to commit to deeper short-run binding emissions reductions

than were politically viable in the U.S. Congress. However, the problem for environmentally-minded politicians was that any attempts at compromise would potentially deny them the necessary praise that environmental groups could bestow upon them to reassure green segments of the electorate.

To thread that needle, the Clinton administration negotiated a greenhouse gas emissions reduction target of minus seven percent below 1990 levels to give environmental groups a big number as an overall target. At the same time, the Kyoto Protocol included provisions for market mechanisms to reduce the overall costs of implementation and forest sinks to reduce the actual emissions reductions that would actually be required to meet their Kyoto obligation.[21] As we now know, while the environmental community provided grudging praise to the Clinton administration for negotiating breakthroughs at Kyoto, the other gambits on mechanisms and sinks were not enough to placate opposition in the Senate, and the Kyoto Protocol was never brought to them for advice and consent.

PART II: New Developments and A Strategy for Reform

In 2006, the Democrats took over control of both houses of Congress, creating what appeared to be a sure-fire environment for stalemate on energy policy with divided government. Ironically, the time may now be ripe for comprehensive energy reform. To explain why this may be so, we need to understand several main features of the contemporary policy context that may help create opportunities for reform.

GATEKEEPERS AND PARTISAN POLITICS

First, some gatekeepers have more authority than others. The president is the first among equals in the U.S. system and can use the power of the bully pulpit to gain support in Congress. Even in the face of Congressional opposition, presidents can "go public" by directly appealing to the American people for support. This can sometimes generate pressure on Congress to enact policies that might otherwise get blocked because of the exercise of interest group influence.[22]

In the context of contemporary developments, President Bush has largely abdicated this role on energy policy, and apart from perseverance in Iraq, he is not using the power of the bully pulpit for many major political purposes as he winds down his presidency. However, in Congress, the Democratic Speaker of the House, Nancy Pelosi, and the House Majority leader, Harry Reid, are attempting to use their powers to corral their majority into supporting comprehensive pieces of legislation on energy and climate change. At first glance, we might think this effort would fail, given that political parties possess far less discipline in the American system compared to other advanced democracies like Britain. In the U.S. context, members of Congress have much more individualized and personalized bases of financial and political support. Despite this structural difference, House and Senate party leaders do possess some powers of agenda-setting over pieces of legislation and committee control.

For example, to overcome the policy inertia brought on by pluralistic societal preferences and fragmented committee control in Congress, House Speaker Nancy Pelosi sought to create a new House Select Committee on Energy Independence and Global Warming. However, longtime Congressman John Dingell, Chairman of the House Committee on Commerce and Energy, vigorously opposed her efforts to give the new committee legislative powers and secured a deal with her that the committee would have an expiration date by the end of October 2008. Despite these limits on the committee's prerogative, Pelosi has been successful shepherding an important pending piece of legislation through Congress that, since passed by both chambers and signed by the president, represents the most significant piece of energy legislation passed in the last 25 years. Rather than subject

their preferred legislation to a formal conference across the House and Senate, Reid and Pelosi hammered out an agreement in secret just among the Democrats.[23]

However, in usual circumstances, this activity would not likely insulate members of Congress from interest group pressure to strip the bill of controversial elements. In 2007, it was somewhat different. Going into an election year in 2008, the Congress is exceedingly unpopular and the tenure of Pelosi and Reid has been seen as ineffectual. Approval ratings of Congress hover in the twenties.[24] While voters may punish the president's party in 2008 for his lackluster performance, so too may they punish Congressional Democrats for having demonstrated so little leadership of their own. This creates more intense pressure on individual legislators to support achievements in Congress that might redound to them at the ballot box.

THE GLOBAL CONTEXT AND POLICY WINDOWS

They now have reason to believe that voters will give them credit in the energy arena. As the political scientist John Kingdon has argued, events sometimes create open "policy windows" in which entrepreneurs are able to match apparent problems with policy solutions.[25] Several problems related to energy, the environment, the economy, and national security have come together to create a sense of urgency for reform in energy policy. September 11, 2001 created a new understanding of the potential security externalities of dependence on foreign oil from volatile parts of the world. Subsequent events in the Middle East, Venezuela, and Nigeria have underscored how political volatility is likely to be a perennial problem, as long as the United States imports more and more oil from abroad. The market, responding to strong Chinese and Indian demand, has made these concerns more salient in 2007, as prices of oil rose to nearly $100 per barrel. The steady drum of reporting on climate change, from Al Gore's film *An Inconvenient Truth* to the IPCC's Fourth Assessment Report, have solidified public perception that the problem is real and increasingly urgent for government to attend to, even if there is still disagreement about what policies are appropriate. Together these factors have opened the window for advocates of comprehensive energy reform to pursue their policy agenda.

PUBLIC OPINION: OPEN BUT NOT COMPLETELY

Public opinion may not be the main barrier to policy reform in the energy arena. On climate change, for example, a variety of polls show rising recognition by the American people that climate change is real.[26] One 2007 poll found that the public strongly supports higher fuel efficiency standards (67 percent), energy efficient buildings (64 percent), and a renewable portfolio standard (55 percent). That said, while public opinion supports these reform measures, other policies, particularly tax policies, face significant opposition: 48 percent strongly opposed a gas tax and 49% strongly opposed an electricity tax. [27] Earlier 2002 to 2003 polls found only soft support for emissions trading compared to other policies.[28]

However, several of these are complex policies that the public likely knows little about and where attitudes are likely to be malleable in response to leadership and events.[29] Both the president, members of Congress, and interest groups can shape public sentiment. Moreover, these patterns are less revealing than at first glance, particularly since they conceal regional and partisan differences. For example, partisan differences remain fairly significant on climate change. While a majority of Republicans acknowledge global warming is real, only a quarter are convinced strong evidence links climate change to human activity.[30] Thus, while public opinion writ large may not pose an insurmountable burden for many policy initiatives, reforms that demand more sacrifice of the American people, that upset the past comfort of low energy policies, are likely to face fierce

resistance. Moreover, strong if not overwhelming skepticism about climate change among Republicans provides Republican members of Congress with cover and incentive to cater to the most vocal extreme views.

PRESIDENTIAL LEADERSHIP IS LIKELY NECESSARY

In 2007, two pieces of legislation were in front of Congress. The first, the Clean Energy Act of 2007, included a number of measures, perhaps most important a revision in the fuel efficiency standards for automobiles for the first time in 32 years.[31] The bill, in its initial form, also included a federal renewable energy portfolio standard.[32] The second, the Lieberman-Warner America's Climate Security Act, would impose an economy-wide cap-and-trade system (see Appendix B for a description of the energy bill and the provisions in Lieberman-Warner).[33]

However, President Bush signaled his intent to veto both bills in their original form. The energy bill was signed by the president but only after it was stripped of tax increases for the petroleum sector and the renewable portfolio standard. The cap-and-trade bill will likely be vetoed, even if it survives a Congressional vote. Like the failed cloture of December 7th, the cap-and-trade bill may suffer a similar fate and never be brought before the Senate for a full vote.

These recent cases suggest presidential acquiescence may be insufficient to guarantee more far-reaching energy policy reform. To that end, a new president in 2009 should make this policy arena one of his or her highest priorities for their first year in office. By the time of their first State of the Union address in January 2010, the president should be able to tell the nation, "This is what we have done." But, the president will likely need to "go public" and appeal directly to the American people in order to prevent a variety of regional and parochial interests from capturing the legislation and jettisoning its more expansive provisions.

THE GEOGRAPHIC PATTERNS OF SUPPORT AND OPPOSITION

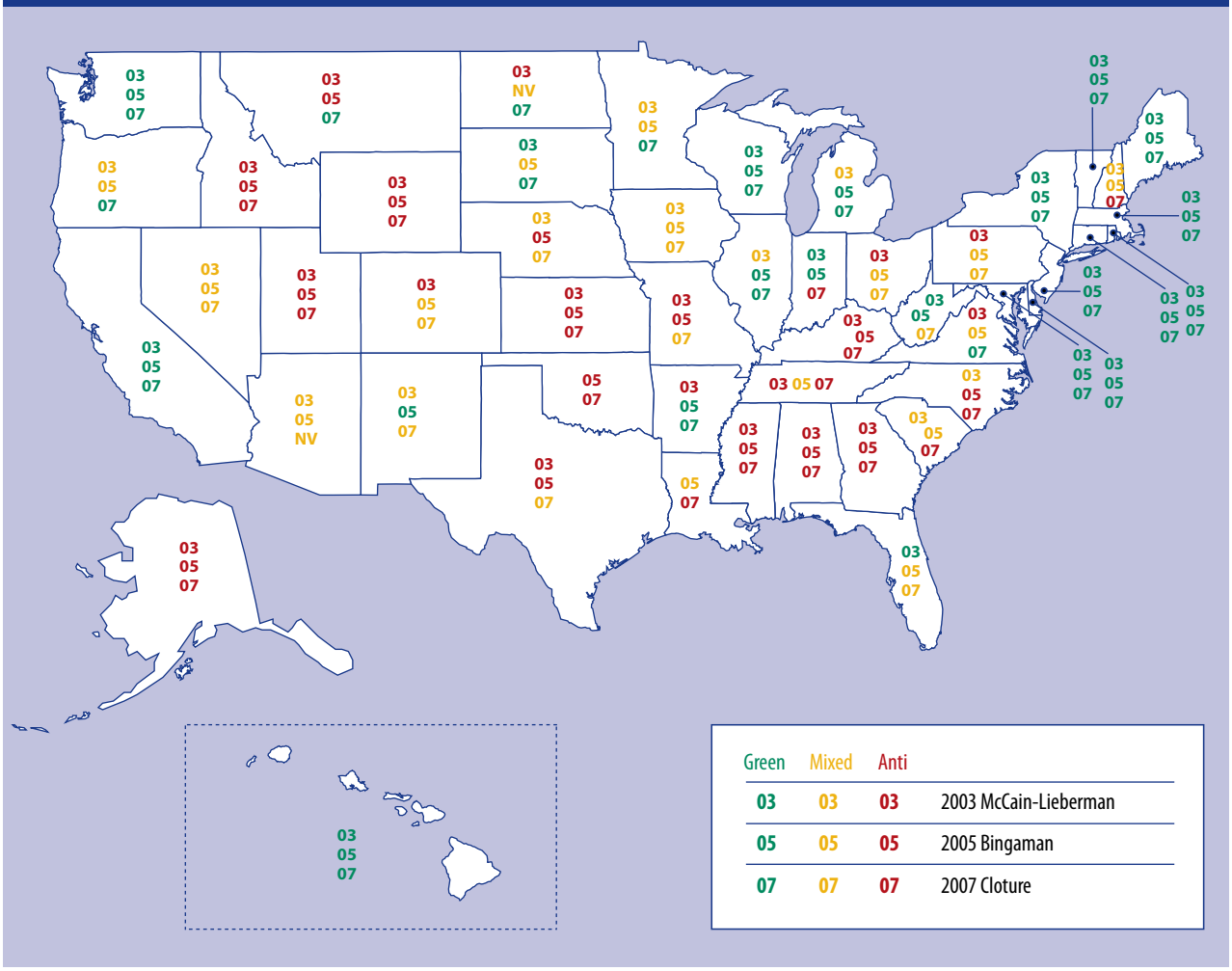
Beyond sustained presidential engagement, the strategy for overcoming political barriers requires a clear-eyed assessment of the geographic bases of support (and potential support) for energy policy reform. While the turnover and sheer number of House members makes a fine-grained analysis of legislator motivations difficult, the smaller size of the Senate can provide some insight into where support and opposition to energy policy reform is based and which states and legislators might be considered swing states/interests if the vote is close. The House approved the 2007 energy bill by a relatively wide margin, 235 to 181. The Senate proved harder to move and will likely remain so, unless the Republicans recapture the House in the 2008 elections or subsequent pieces of energy legislation seek even more dramatic policy change.[34]

To provide traction on the geographic bases of support, I look at three votes in the Senate: (1) the December 7th, 2007 failed cloture vote on the energy bill, (2) the 2005 Bingaman sense of the Senate resolution on a cap-and-trade system, and (3) the failed 2003 vote for the McCain-Lieberman cap-and-trade bill.[35] These votes reveal states where both senators consistently favored energy and climate policy reform and those with senators consistently opposed. We can also observe states with split delegations or where there appeared to be flux. I suggest that these states are likely swing states where changes in representation and/or public pressure could result in a shift in the state's position. From these votes, we can ascribe possible motives to legislators in all three categories: *Green, Mixed, and Anti* (see Figure 1, opposite).

Both senators voted the green position across all three votes in thirteen states: California, Connecticut, Delaware, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, Rhode Island, Vermont, Washington, and Wisconsin. These were concentrated in the *Northeast*. By contrast, senators consistently opposed the green

Figure 1

MAP OF SENATE VOTING PATTERNS ON (1) 2007 CLOTURE (2) 2005 BINGAMAN AND (3) 2003 MCCAIN-LIEBERMAN[36]



Source: Generated by the author from Senate Roll Call Votes

position in ten states: Alabama, Alaska, Georgia, Idaho, Kansas, Kentucky, Mississippi, Oklahoma, Utah, and Wyoming. These were concentrated in the *South* and *West*. Senators voted against two of the three measures in six other states: Louisiana, Missouri, Montana, North Carolina, Tennessee, and Texas.

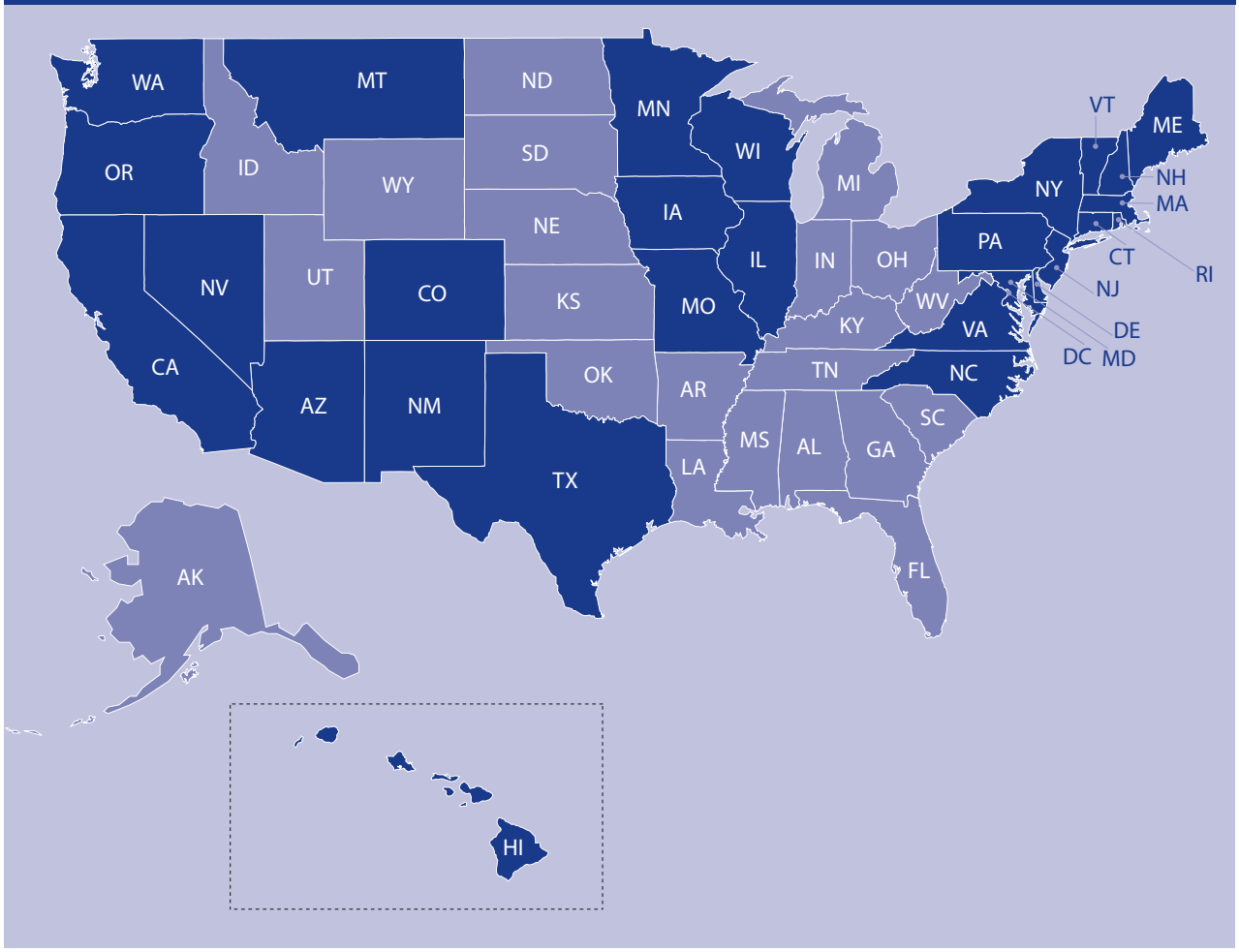
In terms of pivotal swing states, senators supported the environmental position on two of three votes in five states: Arkansas, Illinois, Indiana, Michigan, and South Dakota. Senate delegations split on 2 or more of the votes in another twelve states including Arizona, Florida, Iowa, Minnesota, Nebraska, Nevada, New Hampshire, New Mexico, Ohio, Oregon, Pennsylvania, and South Carolina.

Thus, the Rust Belt and the upper Midwest and pockets of the Southwest appear to be critical areas of potential support.

Looking at the 2007 cloture vote more closely, both senators opposed the cloture motion in sixteen states, meaning they did not want to allow a vote to move forward on a far-reaching energy bill. In 22 states, both senators supported cloture. In ten states, one senator supported the measure and the other did not (or one senator missed the vote). Supporters were concentrated along both coasts while opponents were concentrated in the South. Five Republicans (Coleman of Minnesota, Collins and Snowe of Maine, Smith of Oregon, and Thune of South Dakota) joined 48 Democrats to support cloture. Several Democratic senators voted against cloture, including Bayh of Indiana, Byrd of West Virginia, and Landrieu of Louisiana.[37] Indiana's reliance on coal-based electricity was cited as one rationale for Bayh's opposition as well as moderate Republican Senator Dick Lugar.[38]

Figure 2

STATES WITH RENEWABLE PORTFOLIO STANDARDS
JUNE 2007



Source: U.S. Department of Energy[44]

Coal concerns likely animate Byrd's opposition while the importance of petroleum concerns to Louisiana likely explain Landrieu's opposition.

The interesting cases are where the senators voted differently. In West Virginia, fellow Democrat Jay Rockefeller voted for cloture. Other split delegations include Colorado, Iowa, Missouri, Nebraska, New Mexico, Ohio, and Pennsylvania.[39] These are states where changes in representation or political pressure might be expected to switch the position. Of these states, Allard of Colorado, Hagel of Nebraska, and Domenici of New Mexico are retiring. Republican Senator Sununu of New Hampshire is down in the polls, and the region, aside from New Hampshire, overwhelmingly supports energy and environmental policy reform.[40]

On December 13th, the Senate dropped the renewable portfolio standard portion of the energy bill, which was fiercely opposed by the Southern Company, a holding company for utility companies in the Southeast where renewables have yet to have much of an impact.[41] Other strong opponents of the measure included the Edison Electric Institute, a member institution of investor-owned electric utilities as well as the National Association of Manufacturers and the U.S. Chamber of Commerce.

Dropping the RPS provision brought six more senators to support cloture but a new cloture vote fell one short of the sixty-vote majority.[42] Three of the six were from the Midwest (Grassley of Iowa, Bayh and Lugar of Indiana); others voting to support cloture included Byrd of West Virginia, Murkowski of Alaska, and Hatch of Utah. After the second failed cloture vote, the Senate dropped another controversial measure from the bill, a package of taxes on the petroleum industry. This move left the new fuel efficiency standard on autos and the mandate on ethanol as principal remaining reforms; the Senate passed the bill by a wide margin of 86 to 8 on December 13, and the president signed it into law on December 19th (see Appendix B for a breakdown of the bill's major provisions, including measures that were dropped).[43]

We can seek additional support for these results by looking at which states possess renewable portfolio standards (RPS) or have expressed support for regional cap-and-trade initiatives. As of June 2007, 24 states had an RPS; four others — Illinois, Missouri, Virginia, and Vermont — had voluntary goals. Figure 2, on previous page shows shaded states with RPS.

Regional support for cap-and-trade schemes shows similar patterns (see Figure 3, page 48): strong support on the West Coast, the Northeast, the upper Midwest, and several states in the Southwest. Southern and southeastern states and the Plains states are among the laggards.

States that have both standards but where both senators have not supported energy/climate policy reform might be thought of as swing states. States like this include: Arizona, Iowa, Minnesota, New Hampshire, New Mexico, and Oregon. Other possible swing states might have one standard and not the other or those where they have a voluntary portfolio standard or an observer status with cap-and-trade initiatives. Among these states are Colorado, Pennsylvania, Indiana, South Dakota, and Ohio.

Regionally, the pattern that emerges from all these cases is that legislators from Rust Belt states (Ohio, Pennsylvania, Michigan), Midwestern farm states (Iowa, Indiana, Minnesota, Missouri, South Dakota), and several western states (Arizona, Colorado, New Mexico, Oregon) likely hold the keys to comprehensive energy policy reform. New Hampshire is an outlier in the Northeast and may be moved (see Figure 4, page 49).

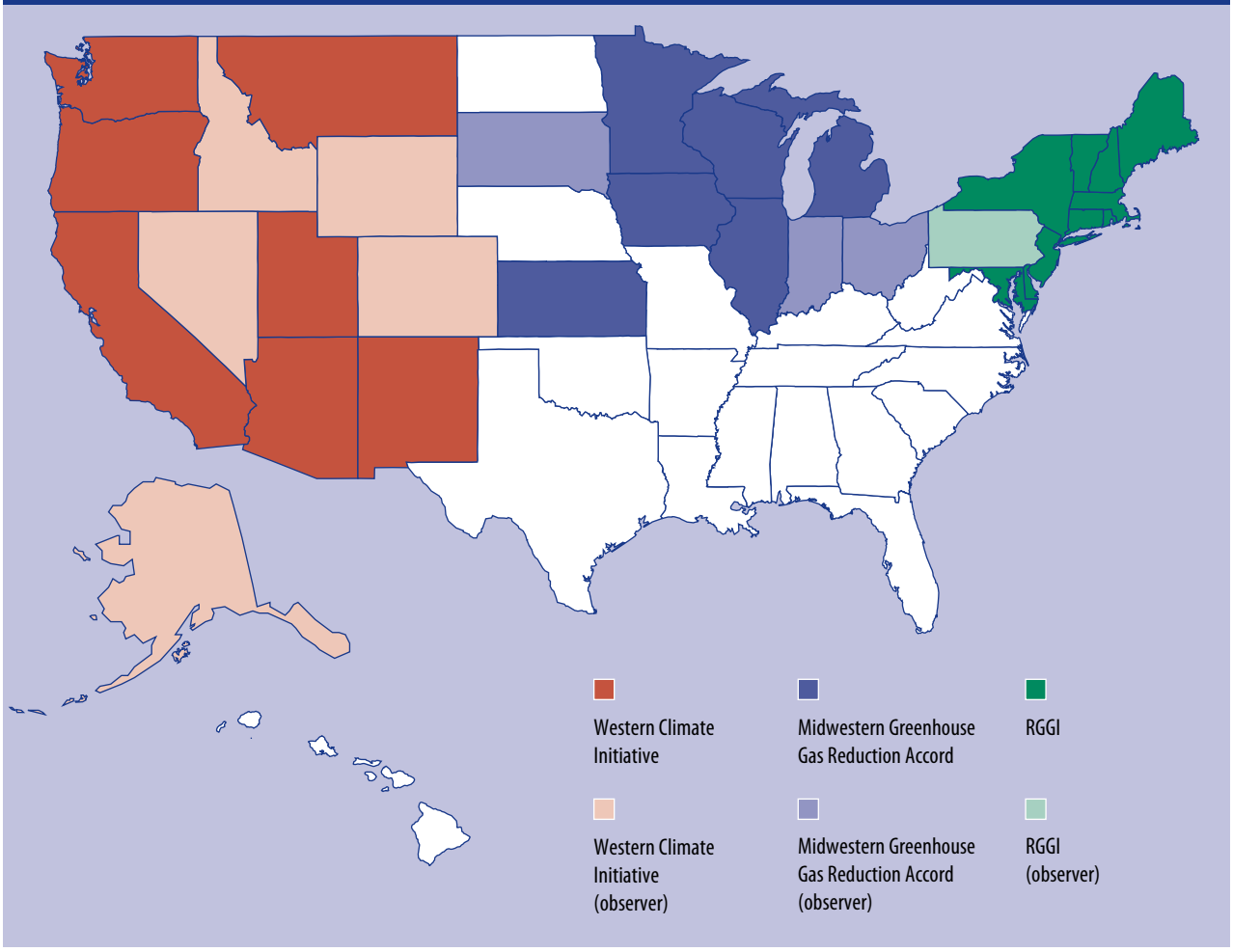
PARTISANSHIP IS IMPORTANT

While both Democrats and Republicans favor policy reform in the energy arena, they may have very different ideas of what constitutes reform. Where Republicans tend to favor lifting environmental restrictions on domestic exploration of oil and gas resources and nuclear power, Democrats tend to favor alternative energy sources. The parties may set aside their differences in support for biofuels, which has the rhetorical attraction of being domestically generated rather than imported from abroad. However, as I note below, biofuels, despite their bipartisan appeal, may be limited in their ability to provide much of U.S. energy needs and be saddled with all sorts of other problems.

At this juncture, Democrats are far more likely than Republicans to support the kind of energy strategy supported by CNAS, particularly the environmental component. However, unless their majority increases after the 2008 elections, support from more Republicans will be needed. On

Figure 3

MAP OF REGIONAL CAP-AND-TRADE INITIATIVES

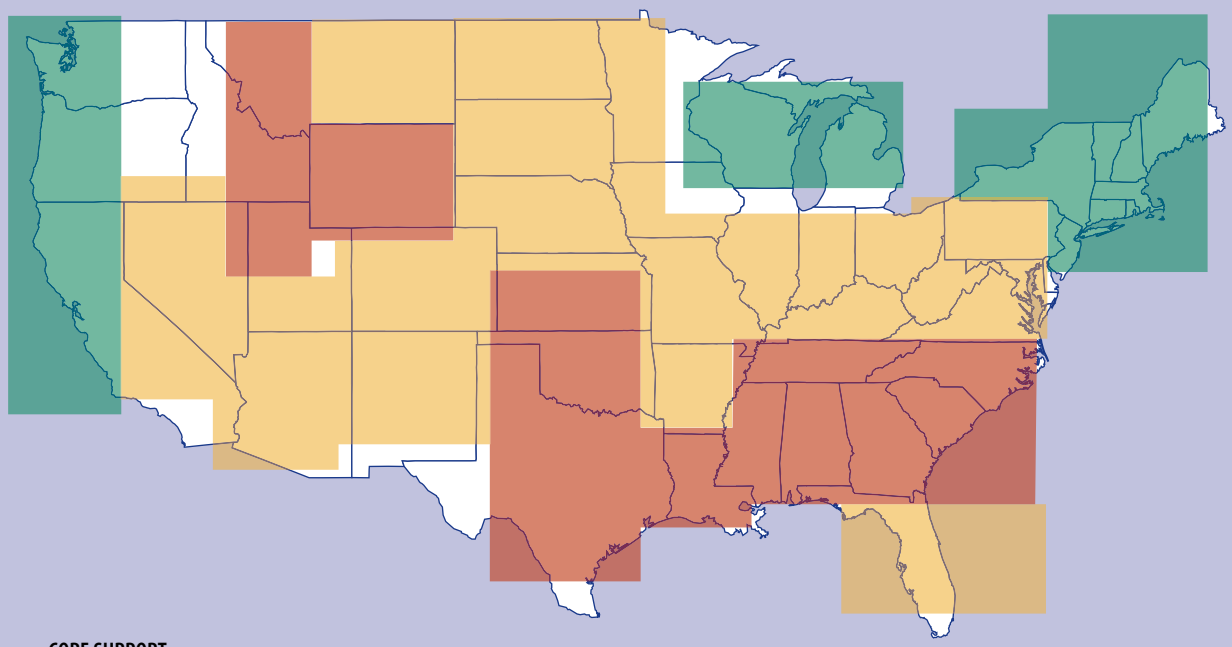


Source: Pew Center on Global Climate Change[45]

the environmental aspects of energy policy, a real information divide looms large. Republicans and Democrats have very different beliefs, for example, about the factual basis behind climate change. In 2006, in a poll of some 113 members of Congress, only 13 percent of Republicans said it had been proven beyond a reasonable doubt that man-made causes were responsible for warming compared to 95 percent of Democrats.[46] An information strategy among Republicans, led by convinced Republicans (such as John McCain, John Warner, Richard Lugar), might be a way to bring in a few more supporters, particularly in swing states that are also politically competitive. For those seeking a change in energy policy, any political strategy has to determine what level of concessions are necessary to get sufficient support without undermining the substance of the bill. Where could this support come from? Already, a number of swing states have been identified in the Midwest, the Rust Belt, and the Southwest.

Figure 4

REGIONAL BASES OF SUPPORT AND OPPOSITION



CORE SUPPORT
- Coasts (Northeast, West)

CORE OPPOSITION
- Southeast and South

SWING STATES
- Rust Belt (Ohio, Pennsylvania, Michigan)
- Midwest (Iowa, Indiana, Minnesota, Missouri, South Dakota)
- Southwest (Arizona, Colorado, New Mexico)
- Regional outliers (New Hampshire)

Pro Swing Anti

THE ECONOMIC BASES OF REGIONAL PREFERENCES

We can dig a little deeper into state-level preferences by looking at the underlying regional economy. For example, a national map of coal mines demonstrates their concentration in a handful of states (West Virginia, Ohio, Pennsylvania, Kentucky, Wyoming, North Dakota, Texas, New Mexico, Colorado, and Utah). Any bill that puts a price on carbon will likely face opposition from legislators from these states, unless coupled with grandfathered permits for coal-fired power plants or incentives for clean coal (see Appendix C for national maps of coal mines, refineries, and renewables).

Similarly, when we look at refineries, we see they are concentrated on the Gulf Coast, New Jersey, California, Washington, and dispersed in a few other localities. While not always determinative of legislative preferences, particularly in states with more diverse economies, measures that tax the oil and gas industry or increase their operating costs through environmental and other measures may draw opposition by local legislators from these areas. Other interests have more to gain from energy policy reform. Non-hydro renewables are concentrated in the Plains states (wind) and the Southwest (solar), making legislators from these states more likely to back support for renewables. While countervailing economic interests also shape legislative preferences, understanding the likely material underpinning of legislative behavior can provide a more nuanced appreciation of local preferences and their likely support for reform measures.

For some policies, it may be necessary to allow for local heterogeneity rather than mandate a one-size-fits-all federal policy. On the renewable portfolio standard, a more delayed timetable to accommodate other regions like the Southeast (that claim they have fewer renewable resources) might be required to get the bill passed. That said, states with standards that exceed the federal requirement (if one is passed) should have the flexibility to retain them. In other areas, where firms produce for a national market, it may be desirable to have a single federal standard to prevent problems like high-cost boutique fuels that currently create regional distortions in gas prices. In December 2007, the EPA, in dismissing California's claims of being able to regulate carbon dioxide emissions on cars, made this argument in defense of the new federal fuel efficiency standard which has a slower timetable for implementation.[47]

Regional policy preferences also derive from other sources of production, not purely based on energy sources. Some regions like the Midwest produce products (like agriculture) that could be used as energy sources while other regions are big users of energy or produce energy-intensive manufactures (the Rust Belt). The Midwest economy remains heavily based on farming, and while biofuels loom larger as a part of the Midwest economy, this sector's preferences are a bit up for grabs, depending upon what additional opportunities farmers can extract from the mix of biofuels or the use of farmland as sinks for carbon, among other considerations. The need for support from Midwestern farm states helps explain why the House bill on energy includes a provision dramatically increasing the target for biofuels. That target mandates the increase in the use of ethanol as a fuel in transportation to 36 billion gallons a year by 2020, up from about 6 billion today (36 billion gallons would be about 25 percent of our transportation fuel needs today).[48] Two-thirds of that would have to be cellulosic, derived from non-corn sources such as switchgrass.[49] Similarly, the need for Rust Belt support helps explain the compromise on fuel efficiency. John Dingell's open support for the bill largely was a result of the agreement on fuel efficiency which maintained separate classes for cars and light trucks, meaning that automakers will be

able to meet the standard for their fleet by building some cars that exceed the 35mpg standard and other heavier vehicles that do not.

VALUES AND RELIGION MATTER, TOO

However, not all preferences derive solely from the bases of production. Regional differences in religiosity and values may also be important. For example, in recent years, the evangelical community, through campaigns like the "What Would Jesus Drive?" effort, has increasingly mobilized to address climate change from a values perspective. However, not all evangelical leaders have endorsed this approach. The Southern Baptist leader Richard Land, for example, has tried to tamp down on formal statements from the evangelical community on the need to address climate change.[50] Interestingly, the Southeast, the primary basis of opposition to energy policy reform, is where Baptists in the United States are overwhelmingly concentrated (see Appendix D). If opposition from the Southeast continues to stymie reform, those seeking energy policy reform might follow the lead of campaigners for debt relief and global AIDS efforts and go directly to some of their most vocal opponents like Land to persuade them to change their views.

In addition to religious attitudes, environmental values may also vary by region. The patterns we observed with the strongest bicoastal support for the three key Senate votes likely reflects, in part, the heavy concentration of environmental group members in those states (see Appendix E).

Without more sophisticated statistical analysis, we cannot say which of these different parameters (security concerns, oil prices, public opinion, partisanship, energy sources, industry, religion, environmental values, etc.) is most important in explaining legislative preferences on energy policy reform. Nonetheless, we have a clearer idea of patterns and the places where policy change is more likely to occur.

Conclusion

Beyond the hope that the next president will seize this issue as his or her own and a geographic focus on swing states, what should energy advocates do? Success will require attention to both the message and substance of the campaign.

THE MESSAGE

With respect to the message, there are a number of different potential "frames" by which an appeal for comprehensive energy reform could be cast. Frames serve as mental shortcuts by which policymakers can sort information and understand a problem's causes, its consequences, and what solutions exist.[51] As suggested earlier, events — 9/11, high oil prices, climate change — have made energy and climate policy more salient. Each of these and other dimensions — national security, economics, environmental impact, religion — could be the basis of an appeal.[52] They already have.

The Energy Future Coalition has based some appeals on national security:

> "Energy is fundamental to U.S. prosperity and national security. With the advent of globalization, the onset of global warming, and the war on terrorism, the complex ties between energy and U.S. national interests have drawn tighter over time."[53]

The Apollo Alliance framed the energy problem in terms of economic opportunity and industrial revitalization:

> "The Apollo Alliance provides a message of optimism and hope, framed around rejuvenating our nation's economy by creating the next generation of American industrial jobs and treating clean energy as an economic and security mandate to rebuild America."[54]

Former Vice President Al Gore, in his film and testimony to Congress, has spoken of climate change as a planetary emergency and a moral calling:

> "I want to testify today about what I believe is a planetary emergency-a crisis that threatens the survival of our civilization and the habitability of the Earth...This is a moral moment of similar magnitude. This is not ultimately about any scientific discussion or political dialogue. It is about who we are as human beings and our capacity to transcend our limitations and rise to meet this challenge."[55]

An evangelical group's appeal on climate change made the argument in terms of Christian values:

> "Christians must care about climate change because we love God the Creator and Jesus our Lord, through whom and for whom the creation was made. This is God's world, and any damage that we do to God's world is an offense against God Himself."[56]

Which of these messages will work best? This is likely to vary by group. As pollsters of consumer products and politics have found, persuasive appeals can often be finely tuned or "micro-targeted" to the individual concerns of the consumer or voter.[57] A pluralistic society may demand a similar variety of frames. There is perhaps one generalizable lesson from the frames mentioned above. On climate change, polling and focus groups by the Frameworks Institute found that optimistic messages based on what could be done to resolve the problem were more persuasive than tactics that emphasized fear of consequences, which seemed to demobilize and lead people to think the problem was insolvable.[58] Survey research my coauthor Bethany Albertson and I have conducted on climate change through Pacific Market Research suggests arguments about the economic opportunities of clean energy are perceived to be stronger than either national security or secular or religious moral appeals.[59]

If our concern is convincing seven U.S. senators to vote for cloture, then choosing a dozen senators we think might be persuadable (based on political vulnerability, regional dynamics, etc) may be appropriate. For them, highly personalized appeals based on the interests of their state, people who they know and trust, and their individual values may work very well.

Presidential leadership may be especially important to convince that handful of legislators to be supportive. Leadership can take two forms, an "inside" and an "outside" strategy. Presidents can bring in potential opponents through personal appeals. A president can seek to play to legislators' egos by inviting them to be part of history and to single them out in the signing ceremony at the White House. Lyndon Johnson co-opted Minority Leader Everett Dirksen in this way to get the 1964 Civil Rights Act passed. Similarly, Harry Truman brought in Arthur Vandenberg to ensure passage of the Marshall Plan after World War II. Presidents may also, to the extent possible, seek to negotiate concessions on the legislation at hand or provide side incentives on other issues of importance. At the same time, a president may need to run an "outside" Washington strategy, a quasi-presidential campaign to directly appeal to voters in swing parts of the country to support reform. Here, visits to the state by the president or high-level functionaries could help shift the political balance by animating local activists to contact their legislators to support energy policy reform. Part of that strategy might involve enlisting influential advocates at the state-level to join as surrogates. Republican Governor Arnold Schwarzenegger of California is one prospect. So too would be CEOs of firms that are now active on climate change such as Lee Scott of Wal-Mart and business members of the USCAP (United States Climate Action Partnership).[60]

THE SUBSTANCE

In their quest to persuade swing state leaders and opponents to support broader energy policy measures, reformers will be tempted to offer concessions. Some deals of political expedience, however, may detract from the substantive contribution to U.S. energy needs or extend subsidies to technologies that offer little gain over the status quo. The energy bill recently passed by Congress had some elements like allowing automobile manufacturers to average across the fleet and incentives for ethanol that may qualify.

Ethanol incentives, in particular, are problematic. A number of analysts have raised concerns particularly about corn-based ethanol. The net savings of greenhouse gases and energy may be little to none. The 2005 energy bill included a mandate that 7.5 million barrels of ethanol be added annually to the fuel supply by 2012, setting off a spike in demand. The amount of corn dedicated to ethanol has increased from 13 percent in 2004 to about 24 percent in 2007.[61] As a result, the price of corn has increased, leading to increased food prices both in the United States and abroad, contributing to political instability in countries like Mexico.[62] There are real limits to the capacity of biofuels to make a substantial contribution to U.S. fuel consumption needs, even with subsidies. The corrosive nature of ethanol requires a new distribution system. Moreover, the non-corn based ethanol sources that are supported by the current bill are not yet market-ready and may not be for some time. Some concessions are the political price of getting a larger reform package through, but advocates must always ask, "Are these tradeoffs worth it?" This question must be answered authoritatively to the extent possible. Otherwise, advocates will make a series of debilitating concessions that will undercut the goals of the campaign.

Finally, perhaps one lesson of the 2007 energy bill is that seeking comprehensive reform all at once may be a bridge too far. Dividing the reform package into different bills-on fuel efficiency, a renewable portfolio standard, on a cap-and-trade system, on investments in technology-may be more politically feasible than bundling a number of controversial provisions that may spur influential constituencies to band together in common opposition. As more discrete packages, the logrolling of opponents ("let's all oppose this thing together") may give way to a more political tractable vote on the merits of the individual or small set of reforms at hand. To that end, CNAS has to decide what constitutes reform, what falls in the basket and what sorts of acceptable compromises are needed to get the bigger pieces passed. What about clearing the way for new nuclear power plants? What about clean coal and carbon sequestration? What about a safety valve? What kind of support for ethanol is appropriate? Would any drilling domestically be desirable or permissible?

The new president will likely have a limited political window—based on the continued salience of the issue and his or her limited stock of political capital—to guide more far-reaching reform through the Congress. Other issues—the winding down of the war in Iraq, a possible recession, new security threats, competing domestic initiatives on health care—could potentially derail or detract from policy change in the energy arena. While significant reforms on energy could be passed in the first year of the new president's term, he or she will have to be sufficiently inclusive in their consultative process to garner sufficient buy-in from important constituencies but not so poll-driven to allow the enterprise to be captured by parochial interests.

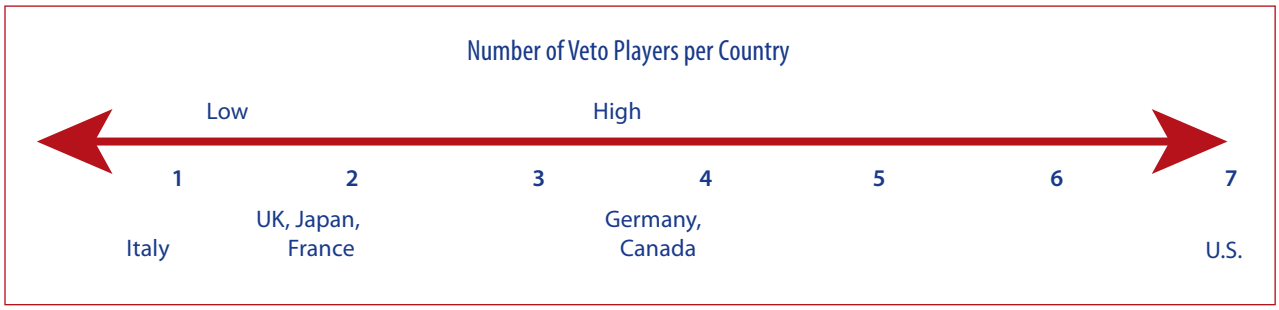
This paper has described the pluralistic nature of energy politics in the United States and offered

some preliminary observations on the regional underpinning of support and opposition to more comprehensive energy reform. The timing for policy change is propitious. Indeed, additional reform packages might survive Senate negotiations and come before the president in the coming weeks and months. Even if that happens, the negotiations process will likely make the project an unfinished business. Unless President Bush experiences a dramatic conversion, the new president in 2009 will likely still face the challenge of passing additional policies — such as a cap-and-trade system — to set the stage for longer-term innovation and guidance of the country's broader energy and environmental needs. In this setting, this paper's identification of swing states, the basis of legislative preferences, the rhetorical opportunities for messaging, and cautions about political concessions ought to serve advocates well.

APPENDIX A

VETO PLAYERS IN THE G7

Here is one measure of veto players in the G7 advanced industrialized countries. The average in 1996 for 23 OECD countries was 1.78.



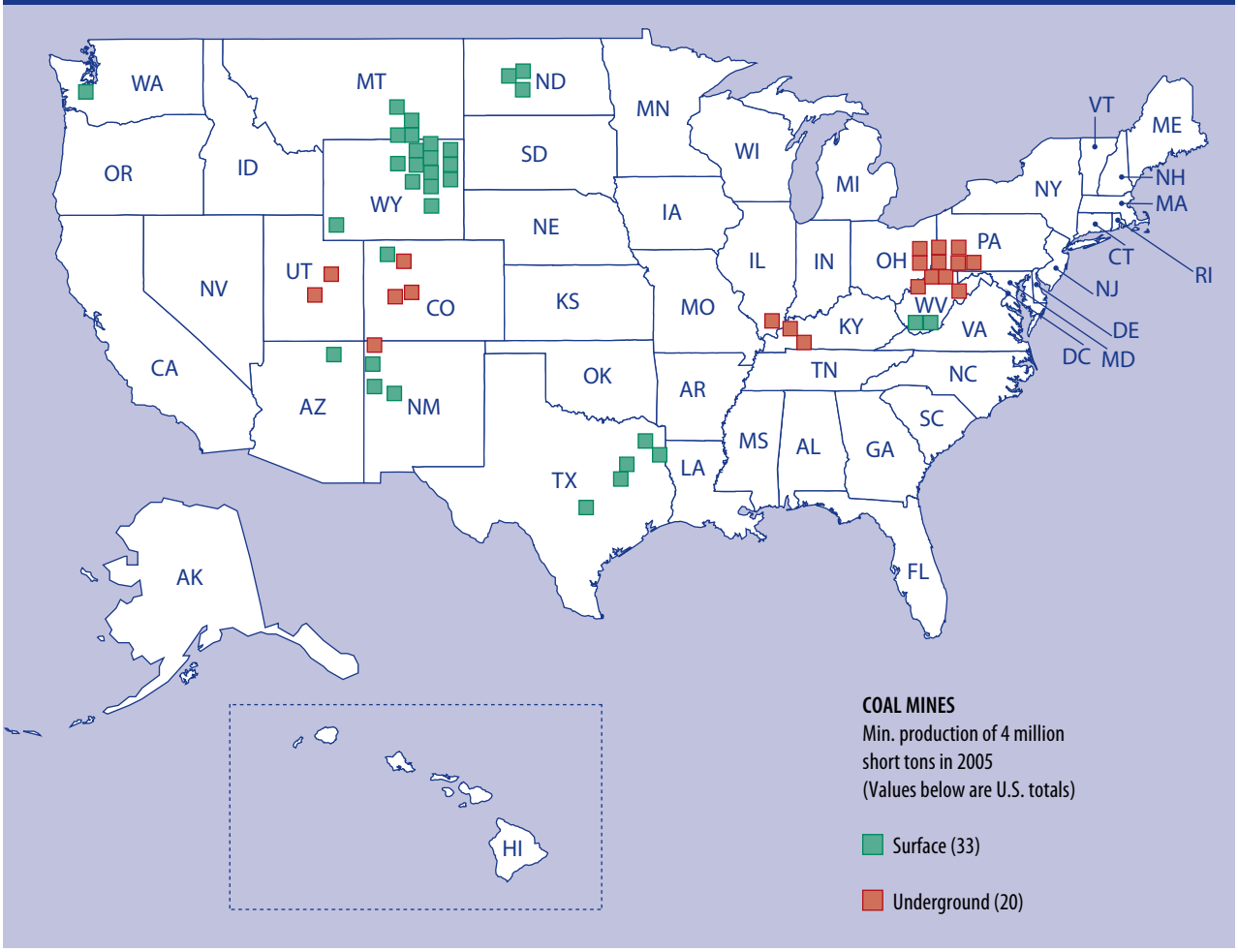
Source: Data from Armingeon, Leimgruber, Beyeler and Menegale 2005.

APPENDIX B

ELEMENTS OF 2007 ENERGY BILL AND OTHER BILLS [63]	
Passed Provisions (from the Clean Energy Act, also referred to as the Renewable Fuels, Consumer Protection, and Energy Efficiency Act and the Energy Independence and Security Act)	➢ **Increased fuel efficiency standards** By 2020, a fuel economy standard of 35 miles per gallon. Auto companies can still average across their fleet of cars. ➢ **Enhanced mandate for biofuels** By 2022, establishes a total Renewable Fuel Standard of 36 billion gallons, up from the current level of 7.5 billion gallons. 2/3 must come from cellulosic sources (i.e. non-corn). ➢ **New standards on light bulbs** By 2012 to 2014, all light bulbs must use 25 to 30 percent less energy than they currently use, setting the stage for the phasing out of incandescent bulbs. ➢ **Additional standards on home appliances** Additional standards on washing machines, dishwashers, and other home appliances. ➢ **Sustained subsidies for nuclear and coal** A different bill, the Omnibus spending bill, provided $30 billion in subsidies for nuclear power and coal.
Dropped Provisions	➢ **Renewable Portfolio Standard (RPS)** A national Renewable Portfolio Standard that required utilities to buy 15% of their energy from renewable sources (solar, wind, hydro, biomass, geothermal) by 2020. ➢ **Elimination of tax breaks for oil companies** A $22 billion tax package that would have cut tax breaks for oil companies. ➢ **Extended tax credits for renewables** An extension to an investment tax credit for renewable power generation from solar, wind, and biomass.
Other Pending Bills (Lieberman-Warner is one example of several pending bills) [64]	➢ **Cap-and-trade** • Economy wide, all six greenhouse gases • Upstream for transport, downstream for coal users • 4% below 2005 level in 2012, 19% below 2005 level in 2030 • 37% below 2005 level in 2030, 55% below in 2040 • Increasing auction: 26.5% in 2012, rising to 69.5% from 2031 – 2050 • Some sectoral allocations • Limits on domestic, international offsets, company borrowing (15%)

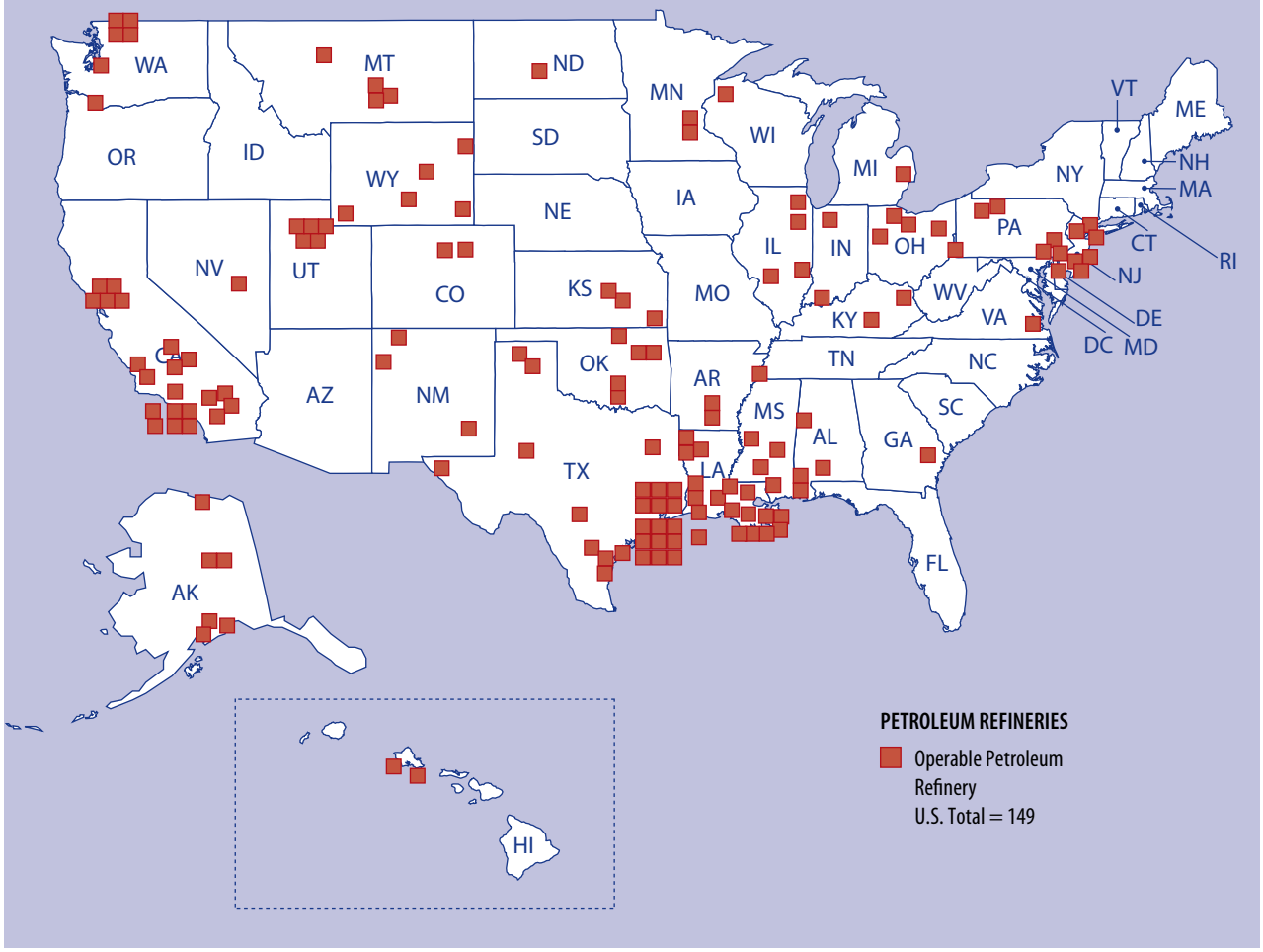
APPENDIX C

MAP OF COAL MINES



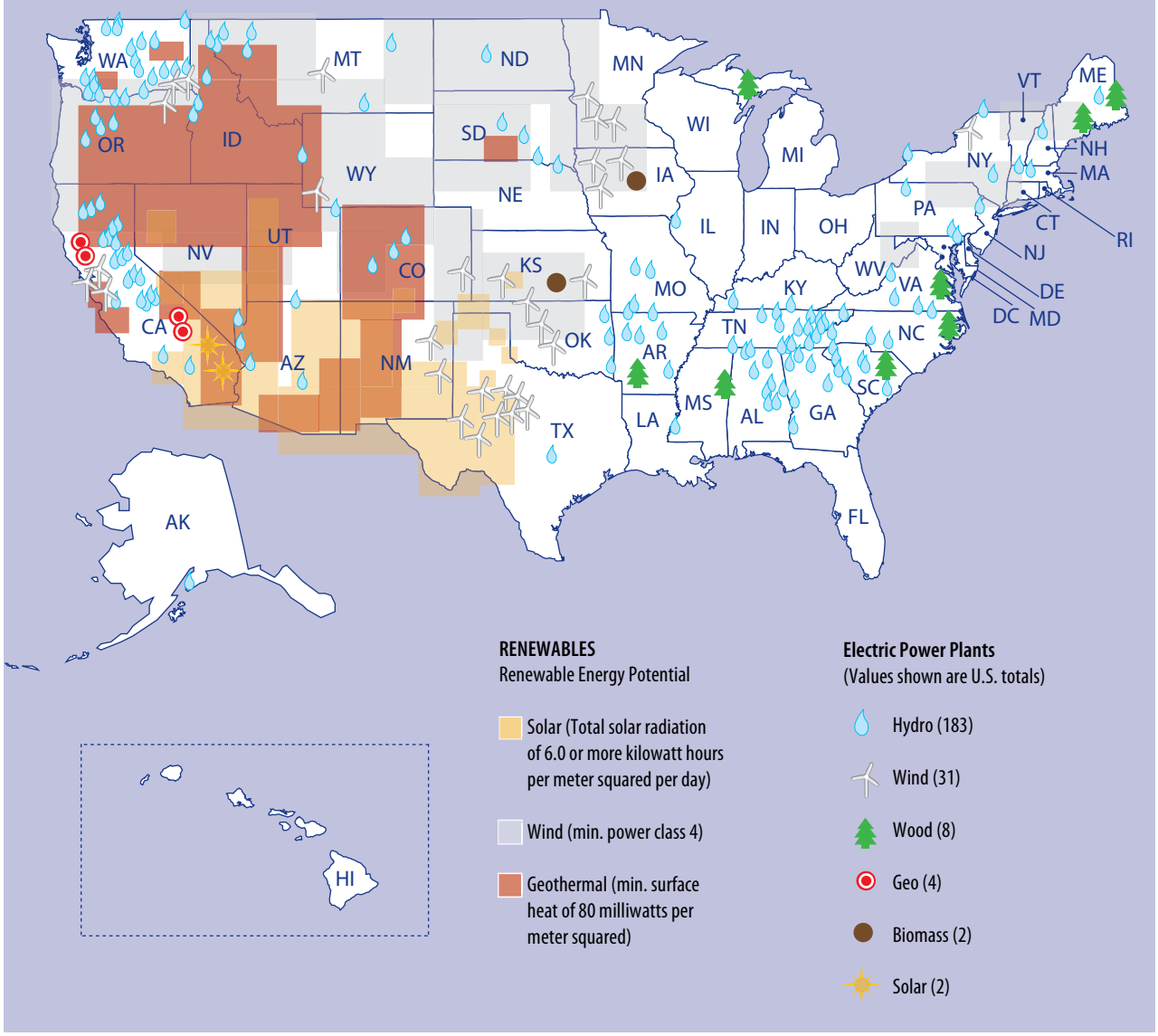
Source: Energy Information Administration

MAP OF REFINERIES



Source: Energy Information Administration

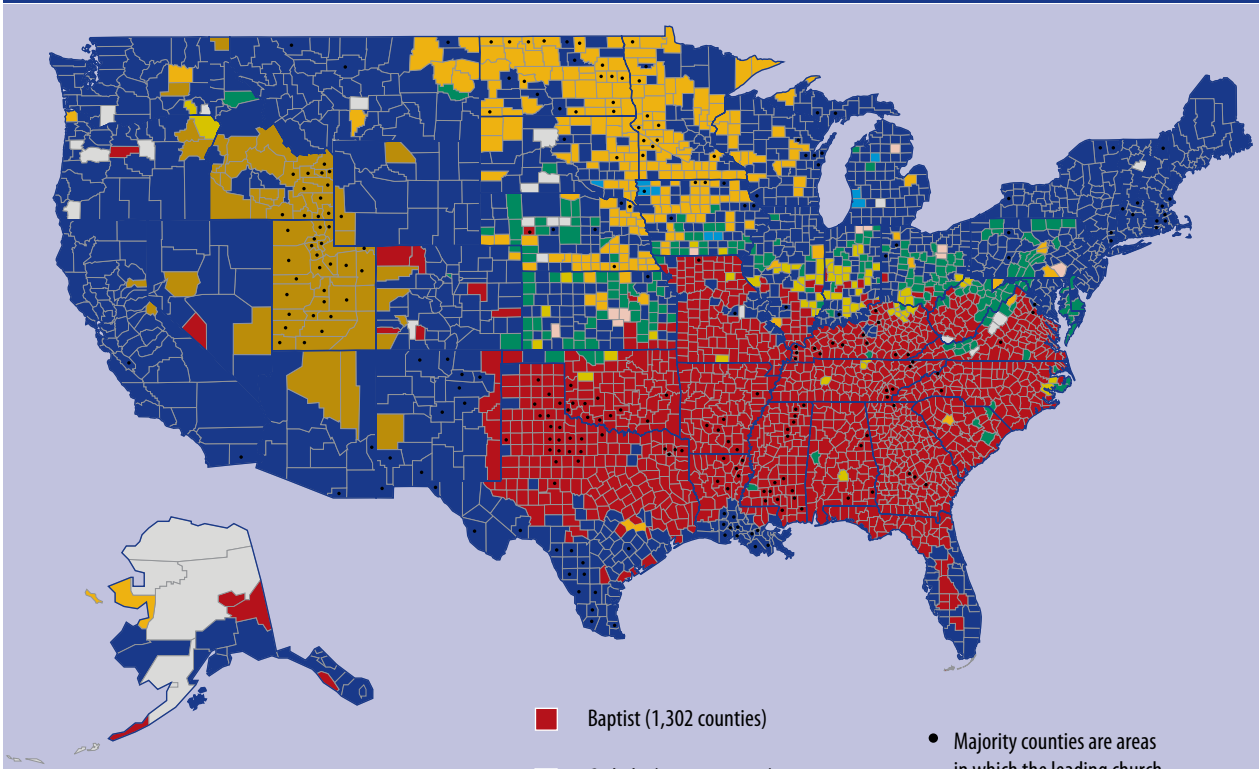
MAP OF RENEWABLES



Source: Energy Information Administration

APPENDIX D

LEADING CHURCH BODIES BY REGION, 2000[66]



- Baptist (1,302 counties)
- Catholic (1,164 counties)
- Christian (72 counties)
- Latter-Day Saints (80 counties)
- Lutheran (250 counties)
- Mennonite (10 counties)
- Methodist (219 counties)
- Reformed (9 counties)
- Other* (35 counties)

• Majority counties are areas in which the leading church body claims 50 percent or more of the population.

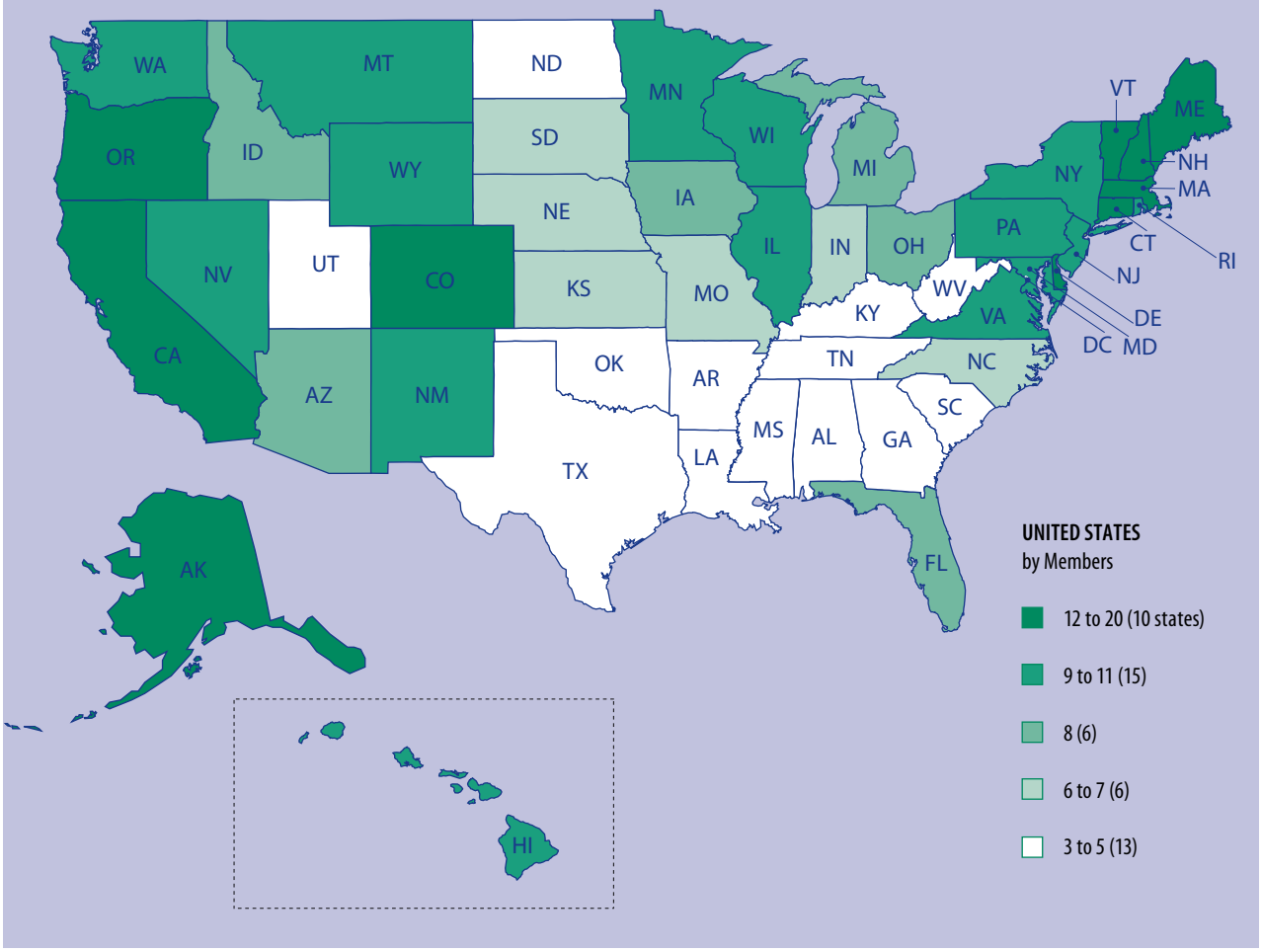
*Other:
1. Adventist
2. Anglican
3. Brethren
4. Friends
5. Orthodox
6. Pentecostal
7. Presbyterian
8. United Church of Christ
9. None

County designations are based on the total number of adherents reported by each church body divided by the county population in 2000.

Source: Religious Congregations and Membership in the United States, 2000. © 2002 ASARB. Available: [CD-ROM]. Nashville, TN: Glenmary Research Center.

APPENDIX E

ENVIRONMENTAL MEMBERSHIP BY STATE, 1999[67]



Source: Mazur and Welch

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ENDNOTES

[1] Gore 1992.

[2] Lohr 1993.

[3] Passell 1997.

[4] The tax was modified to be collected where the ultimate end-user takes delivery rather than an earlier stage in the process. New York Times 1993.

[5] UNFCCC 1998.

[6] The vote was close 219-213. Pianin and Hilzenrath 1993.

[7] Hilzenrath 1993.

[8] Bodansky 2001, 52; O'Keefe 2003.

[9] Busby 2007.

[10] Veto players theory is rooted in comparative politics but has been increasingly incorporated into international political economy. Vreeland 2004; Mansfield, Milner and Pevehouse 2005.

[11] Tsebelis 2002, 25.

[12] Tsebelis 2002, 25.

[13] Huber and Stephens 2001, 55-56.

[14] Data from Armingeon, Leimgruber, Beyeler and Menegale 2005. This is an additive index of five measures of constitutional structure including federalism, presidentialism, bicameralism, proportional representation, and use of referenda. For alternative measures, contact the author.

[15] Tsebelis 2002, 81.

[16] Mufson and Weisman 2007a.

[17] Cummings 2007.

[18] Victor, House and Joy 2005.

[19] For a discussion of safety valve politics, see Bodansky 2001; Nesmith 2003.

[20] I discuss the politics of the safety valve in more detail in Chapter 6 of Busby 2004.

[21] I discuss how environmental groups shaped the metrics of acceptable "green" policies at Kyoto in Chapter 5 of Busby 2004.

[22] Kernell 1997.

[23] Hebert 2007.

[24] PollingReport.com 2007.

[25] Kingdon 1995.

[26] This was the conclusion of a review of sixteen polls taken in 2006 and 2007, several of which contained multi-year tracking data showing increased concern among Americans about climate change. Environmental and Energy Study Institute 2007.

[27] Leiserowitz 2007.

[28] A 2002-2003 poll found only 40% supported emissions trading compared to the 90% that favored reduction of U.S. emissions and 88% that supported the Kyoto Protocol. Leiserowitz 2006.

[29] For example, a March 2007 Gallup poll found that the percentage of people who worry a great deal about climate change had increased by 15% in just three years, up to 41%. Environmental and Energy Study Institute 2007.

[30] In 2006, a Pew Center poll found that a majority of Democrats (81%), Republicans (58%), and Independents (71%) agree that there is solid evidence of global warming. However, only 24% of Republicans were willing to say there was solid evidence that this was due to human activity, compared to 54% of Democrats and 47% of Independents. The Pew Research Center for the People & the Press 2006.

[31] Vehicle fleets would be required to average 35 miles per gallon by 2020, a 40 percent increase over the current standard. Automakers would still be able to achieve this standard by averaging across their fleet. Broder and Maynard 2007.

[32] By 2020, utilities would have to generate at least 15 percent of their electricity sources using renewable energy such as wind or solar power.

[33] On December 5, 2007, this bill got reported out of the Senate Environment and Public Works Committee by a vote of 11-8. All of the Democrats on the committee voted in favor. John Warner was the sole Republican to vote in favor.

[34] Only 14 of 188 Republicans who voted on the energy bill supported it. House of Representatives 2007.

[35] A yes vote on cloture was the environmental vote. The vote on the Bingaman amendment was for tabling the amendment. A no vote was the environmental vote. This was a non-binding resolution so perhaps less telling than other votes. A yes vote on the McCain-Lieberman bill was the pro-environment position.

[36] Contact the author for the data. U.S. Senate 2003; U.S. Senate 2005; U.S. Senate 2007a.

[37] U.S. Senate 2007a.

[38] Groppe 2007.

[39] Three other cases (Florida, Nevada, and Texas) included one non-voting member.

[40] Wilson 2007.

[41] The Southern Company is a holding company for Georgia, Alabama and Mississippi utilities. In the first half of 2007, the firm spent more than $7 million on its own in-house lobbyists and an additional $1.1 million for outside lobbying firms on energy and environmental issues. Mufson and Weisman 2007b. Other RPS opponents included the Tennessee Valley Authority and Duke Energy.

[42] U.S. Senate 2007b.

[43] Broder 2007.

[44] Department of Energy 2007.

[45] Pew Center on Global Climate Change 2007b.

[46] National Journal 2007.

[47] Thomas and Werner 2007.

[48] Hargreaves 2007.

[49] Weisman and Mufson 2007.

[50] Goodstein 2006.

[51] Zald 1996, 262.

[52] See for example, page 57 in Busby and Ochs 2004.

[53] Energy Future Coalition Undated.

[54] Apollo Alliance Undated.

[55] Gore 2007.

[56] Evangelical Climate Initiative 2006.

[57] Sosnik, Dowd and Fournier 2006.

[58] Retallak 2006.

[59] This is unpublished material. Contact the author for more information.

[60] See the USCAP website for a list of members http://www.us-cap.org/

[61] Simon 2007. In late 2007, a bushel of corn cost $3.5, up from $2 about two years earlier. Ethanol demand was blamed as was a deep frost.

[62] Runge and Senauer 2007.

[63] Environmental News Services 2007; LaMonica 2007; Morse 2007.

[64] Pew Center on Global Climate Change 2007a.

[65] Energy Information Administration 2007.

[66] Glenmary Research Center 2000.

[67] Mazur and Welch 1999. Data reflects members per thousand population in the following environmental groups: Sierra Club, National Wildlife Federation, and Greenpeace.

CHAPTER III:
ENERGY, CLIMATE CHANGE, AND PUBLIC OPINION

By Christine Matthews

A Strategy for American Power:
Energy, Climate, and National Security

ENERGY, CLIMATE CHANGE, AND PUBLIC OPINION

By Christine Matthews[1]

Introduction

Any discussion of energy in this country begins with acknowledging, as President Bush declared in his 2006 State of the Union address, "America is addicted to oil." And, unfortunately, most of this oil comes from other countries — nearly 60 percent and growing.[2] Increasingly, the American public has become fed up with this dependence on foreign oil. Many view it as the most significant threat to our national security. In fact, in a 2006 Pew Research poll, Americans ranked "decreasing our dependence on Mideast oil" ahead of "increased defense spending for preparedness" as a way to reduce our vulnerability to terrorism.[3]

As the war in Iraq continues into its fifth year, and as gas prices escalate at home, Americans are looking for solutions to our dependence on foreign oil. At the same time, the public has become increasingly aware of the issue of global warming and the role fossil fuels play. Al Gore's 2006 movie "An Inconvenient Truth" capitalized on this growing awareness and brought it to the forefront. Today, climate change is one of the most discussed and debated issues by lawmakers and the media.

These forces are combining to create a sentiment of public opinion that is centered on changing the way we generate and use energy in this country. Presidential candidates are discussing it and Congress has several bills in the pipeline that attempt to address the issue. The key question is: How far and how fast are Americans willing to go to fundamentally change the way we consume energy and what paths should be taken?

The Political Landscape

There is no question that the political landscape, when it comes to energy and environmental issues, is heavily influenced by public opinion. In the 2008 presidential election, these issues will shape the political landscape more than usual.

Democrats generally favor using federal legislation to address global climate change, and tend to support mandatory, rather than voluntary, actions. The remaining Democratic presidential candidates — Senators Clinton and Obama — fit solidly within that trend and have proposed solutions that move aggressively to reduce our carbon dioxide output. On the Republican side, Senator John McCain is making a priority of energy security and climate change, with the latter being unusual for a Republican. During the 2008 Republican presidential primary contest, several of the leading candidates brought up the issue of U.S. dependence on foreign oil, strictly as a security measure, and were comfortable advocating more domestic oil drilling and increased use of American coal — actions at odds with attempts to curb global warming. Senator McCain, while opting for a less aggressive approach to carbon reduction than either Senators Clinton or Obama, stood alone among the Republican candidates in his dual focus on climate change and reduced dependence on foreign oil.

The next president will come into office with a public position on these issues and, quite possibly, competing pressure from the constituencies that helped elect him or her. The new president will also take office at a time of fierce competing priorities. Even with rising public concerns about climate change and energy dependence, there is also widespread and acute concern for the economy, escalating prices, health care, the wars in Iraq and Afghanistan, immigration, and other pressing issues. The pertinent question for the next president then is how to move energy security and climate change to the top of the list. That will require starting with a) the political will and b) a message that can be effectively communicated to the American public.

Communicating about Energy, National Security, and the Environment

The first and most obvious message, one with broad and urgent appeal to almost all Americans, has to do with the national security and economic dangers of relying too heavily on other countries for our energy sources. In particular, Americans are concerned about relying on the Middle East. This message has been advanced by Republicans, but is of equal concern to Democrats and Independents.[4] While Democrats are dually concerned about reducing our reliance on foreign oil and protecting the environment and curbing global warming, Republicans have tended to place a lower priority on global warming and are primarily focused on the issue of oil dependence.

In looking at what the public is willing to do to address these issues, current polling indicates people adamantly oppose a gasoline tax, or a tax on their carbon consumption, or a tax on their electricity. But the public is fine with a tax on corporate carbon or setting strict corporate emissions limits.[5]

Americans *are* willing, however, to make sacrifices themselves: Three-fourths of Americans are willing to pay at least $25 more per month in electricity if it helped reduce our dependence on foreign sources of energy (consistent across partisan lines). This is not just an elite issue: 63 percent of those earning less than $30K per year are willing to pay more, as are up to 85 percent of those earning more than $100K per year.[6]

Indeed, there are other messages about energy security and climate change that appeal to many Americans. Climate change has traditionally been portrayed as an environmental concern. And while this is traditionally more comfortable terrain for Democrats, more conservative voters are open to environmental concerns, too, depending on how the issues are framed. For example, there is great

support among the public for clean energy, particularly when it is pitched as a matter of local public health: 71 percent of Americans would pay at least $25 more on their electricity bill if the source of their energy "produced no toxic air pollutants such as sulfur, mercury, or ash," and a similar number, 72 percent, would pay at least $25 extra per month for renewable energy.[7]

Environmental concerns in a global sense can also appeal to a diverse range of voters. Nine in ten voters think that protecting the environment is a moral issue.[8] It's important, however, to understand what "moral" means, in this case. In Europe, where nations tend to be more willing to enact broad legislation on environmental issues, the public largely views climate change as a moral issue in terms of an obligation to help developing nations, including helping them deal with the social and political implications of climate change. Americans, on the other hand, are more likely to define "moral" in more nationalistic terms, as a matter of God and country, so environmental protection lacks broad appeal when it is framed as a program to transfer billions of dollars to other countries, but becomes attractive as a factor in American quality of life.

While there is general concern (more acute among Democrats) about climate change, the issue itself motivates less actual willingness to make personal sacrifices than does a goal of reducing energy dependence. Beneath that lies a lack of urgency as well. In a recent Gallup poll, the majority of Americans favored taking some additional actions on behalf of the environment over more immediate, drastic actions.[9]

It is important to take into account, however, that this is a shifting issue. In recent years, there has been a profound reordering of the public's environmental concerns. Even as little as three years ago, when pollsters asked what the top environmental concern was, answers were split among air pollution, water pollution, loss of land and habitat, and sprawl, with no mention of global warming. Today, global warming has risen to the top tier of concerns. This has been an enormous shift, and it is a clear tipping point that has only just occurred.

States at the Forefront

Almost all of the action on changing our energy habits is occurring at the state or even local levels. The federal government is going to have to play catch up. The EPA is scrambling to try to get a grip on states that have — independent of federal inaction — passed strict carbon emissions standards and are requiring utilities to expand their portfolio of clean energy.

Three-fourths of American voters favor "setting limits at the state level on the amount of carbon dioxide any new power plants built in that state could emit," and two-thirds support "requiring electric utilities to get a certain percentage of their electricity from renewable clean energy, such as wind and solar, even if that increases the cost of electricity."[10]

Lawmakers at the state level are seeing the same survey data. Key evidence of this is the number of recent public fights over plans for coal-fired power plants (Texas, Kansas, and Oklahoma, among others) where utilities obtained permission to add new capacity, but plans were ultimately denied by regulators and lawmakers.

If the energy and climate change message itself needs fine tuning, so do the messengers. Trends in public opinion and action outside the federal government also make clear that there is an opportunity to build pressure on Washington from the bottom up, and that suggests that messengers other than national political figures may be especially effective right now. Particularly for Republicans, much of the struggle to define these

issues is happening at the state level, and certainly governors, and sometimes mayors, can exert more pressure on legislators in Washington.

Often political analysts focus on gatekeepers at the federal level in devising legislative strategies.[11] However, governors are also gatekeepers, and tend to be progressive in the sense that they more easily adjust to dynamic public opinion and shifting voter attitudes. On the Republican side, many governors are progressive on energy and climate change, and indeed, there are Republican governors in many of the states that have climate action plans, climate commissions, or executive branch advisory groups. And these states are often the same states whose federal legislators do not act — in the South and up through the Great Plains states. These governors in particular are in a unique position to exert bottom-up influence on lawmakers in Washington.

The private sector also offers opportunities for new and effective messengers. When businesses see regulations coming down the pike, they tend to get on board early to support legislative changes that they can help mold to their best interests, creating a possible wedge to gain support. The business community is also not monolithic; for instance, the oil and natural gas industries are just now being recognized as not being one voice, in part because the natural gas industry sees itself as a logical partner with renewables such as wind and solar in a clean energy future. Business interests are beginning to distinguish themselves on energy and environmental policy, and exert corresponding upward pressure. Oil and coal interests, however, maintain significant influence over lawmakers — particularly in states whose economies are tied to these industries.

Consulting with the private sector can also have effects adverse to energy security, of course. The unfortunate alliance between money and politics and policy, and many big energy or energy-intensive companies, has traditionally driven contributions to Republican candidates. This has created a situation wherein Republicans mostly hear from business interests that want no change, rather than hearing from their full range of constituencies. One of the most vivid recent examples was when the Bush administration via Vice President Cheney consulted with a range of private and public sector groups and individuals in determining energy policy. It eventually came to light that the overwhelming majority of these meetings were reportedly with energy industry representatives — oil companies, coal companies, utilities and the like — with little outreach to environmental or consumer groups.[12] Policy makers need to be better able to hear from other groups, such as sportsmen, religious communities, smaller businesses, and other concerned sectors of the public, and receive a fitting level of pressure from them.

Taking a bottom-up approach is an important way to leverage favorable public opinion in ways that do not always extend all the way to federal decision making. Conversely, federal policy is sometimes modeled on or derived from state policies. It is therefore critical that federal leaders take advantage of public opinion and action on energy and climate change, and build from the innovative ideas bubbling up around the country.

Broadening the Constituency

The state of today's political situation, with such a broad array of top concerns and regional differences in policy priorities, requires above all else that there are strong public opinion trends behind any action governments at all levels try to take on energy security or climate change. One way to make sure the trends are favorable is to ensure that decision-makers frame their goals, their policy plans, and their messages to capture the interests and preferences of a diverse range of public audiences — rather than just talking to one base

or another. Different groups see threats to their best interests in different ways: some people are economically vulnerable to changes in energy prices, for example, and others depend on a healthy environment for their livelihoods or hobbies. Luckily there are some indicators that point to how to break apart these different framings and broaden the constituency for an energy security message that includes environmental concerns.

As discussed, framing the range of energy concerns in national security terms appeals to the broadest range of audiences. But there are ways to appeal more directly to new niche audiences, especially when it comes to climate change. Indeed, right now, climate change messaging, in particular, tends to be aimed at audiences that already agree with the message, and often with the messenger — who is generally going to be a Democrat. This will need to be enlarged.

In a nutshell, it will be very difficult for the nation's leaders to overcome political barriers to energy policy without achieving a significant shift in conservative opinions. Fortunately, there are amenable conservative groups that can serve as a leading edge, if they are courted. One example is the segment of the evangelical community now striving for "creation care" and good environmental stewardship. A group of leaders in this community under the moniker of the "Evangelical Climate Initiative" recently released a statement in which they called Christians to act on an urgent basis to combat climate change. The statement outlined four principles:

- Human-induced climate change is real;
- The consequences of climate change will be significant and will hit the poor the hardest;
- Christian moral convictions demand our response to the climate change problem; and
- The need to act now is urgent. Governments, businesses, churches, and individuals all have a role to play in addressing climate change — starting now.[13]

Another sympathetic group that tends to be politically conservative is sportsmen and -women. A few years back, I conducted a large national survey (and several statewide surveys) of hunters and anglers for the National Wildlife Foundation. Respondents were overwhelmingly concerned about issues such as clean air, clean water, and global warming. Indeed, President Bush and other Republican leaders have consulted with members of Ducks Unlimited and other hunter and angler groups; other leaders working on energy security and climate change need to do the same.

Conclusion

While there are many positive trends in public opinion for national leaders to consider, and while a public consensus is finally building that climate change is a real, human-caused problem, there still seems to be considerable distance to travel. The United States has not yet hit a public opinion tipping point that we need to do something *immediately*, never mind what it is we should actually do. To motivate the public to cross these thresholds, policy makers should particularly focus on framing the problem to the American people as dependence on foreign oil, and then use that as a platform for building a broader consensus for change.

But political leaders also need to be prepared for catalyzing events, and make good use of such events to push the American public past the tipping point on urgency and appropriate action. A regional economic tipping point in the South, for example, which lags behind other regions of the country in concern about global warming and climate change, could result from those populations having to pay enormous flood insurance

prices or become unable to purchase insurance at all. Underwriters in those areas are already today admitting that global warming could bring on a rise in extreme weather events. When the citizens of the coastal southern United States have to pay more in flood insurance, they will put pressure on their politicians to ensure their economic wellbeing.

And while a great deal of discussion centers around the global consequences of climate change, it may be just one species or one situation that brings about a sense of immediacy. For example, the EPA is due to act on the status of polar bears any day now and, if not now, then certainly in the future, the polar bear will reach endangered status. Will this be a galvanizing moment?

The nation's leaders must be diverse in their framings of these issues and vigilant of tipping points that may come from unexpected places in the continuing quest of getting public opinion behind their actions on energy security and climate change issues. At the end of the day, there is a reason the American public is so reluctant on this issue: they understand on a gut level that believing that energy and climate change are urgent issues that require action is ultimately going to mean sacrifice. Indeed, perhaps the most important strategy for changing hearts and minds on these issues is to proceed with humility: there are high stakes and probably high costs involved, and difficult tradeoffs to be made, and people do understand that.

ENDNOTES

[1] This paper was written based on a transcript of the author's comments, questions, and debates at the "Solarium II: A Strategy for America's Energy Security" CNAS event on January 10, 2008, where she served as a panelist.

[2] Justin Blum, "Bill Wouldn't Wean U.S. off Oil Imports, Analysts Say," *The Washington Post* (26 July 2005): A01.

[3] Pew Research Center, "Diminished Public Appetite for Military Force and Mideast Oil," Summary of Findings (6 September 2006), at http://people-press.org/reports/display.php3?ReportID=288.

[4] From a survey of 1,000 U.S. voters conducted by Bellwether Research & Consulting from the American Clean Skies Foundation (January 2008).

[5] American Clean Skies Foundation Survey (January 2008).

[6] American Clean Skies Foundation Survey (January 2008).

[7] American Clean Skies Foundation Survey (January 2008).

[8] American Clean Skies Foundation Survey (January 2008).

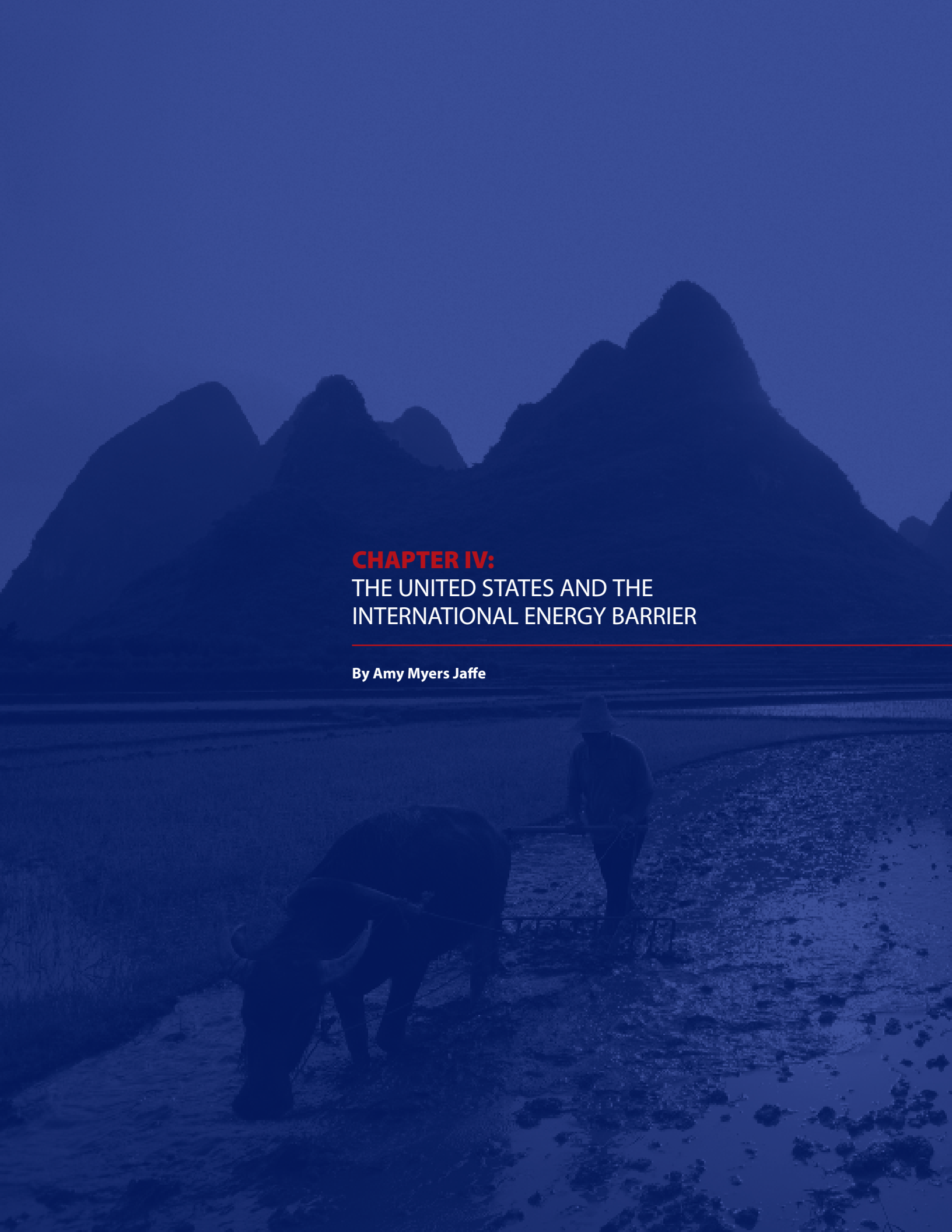
[9] Gallup Poll of 1,012 adults (March 2008).

[10] American Clean Skies Foundation Survey (January 2008).

[11] See, for example, Josh Busby, "Overcoming Political Barriers to Reform in Energy Policy," draft paper for the CNAS project *Solarium II: A Strategy for America's Energy Security* (Washington, DC: Center for a New American Security, 2008), at http://www.cnas.org/en/cms/?1608.

[12] Michael Abramowitz and Steven Mufson, "Papers Detail Industry's Role in Cheney's Energy Report," *The Washington Post* (18 July 2001): A01.

[13] Evangelical Climate Initiative, "Statement of the Evangelical Climate Initiative," at http://www.christiansandclimate.org/statement (accessed 5 May 2008).



CHAPTER IV:
THE UNITED STATES AND THE INTERNATIONAL ENERGY BARRIER

By Amy Myers Jaffe

A Strategy for American Power:
Energy, Climate, and National Security

THE UNITED STATES AND THE INTERNATIONAL ENERGY BARRIER

By Amy Myers Jaffe

A key barrier the United States must tackle in working towards energy security is the difficult nature of the international energy problems the world faces today. The international community is facing the most challenging energy market it has seen in two decades. Oil price volatility has included record swings; capacity surpluses across the operational chain have disappeared; and significant gains in demand are being driven by the expanding economies of Asia. Many emerging economies, such as China and India, have made substantial per capita income improvements in the past decade and are at the launching point where private automobile ownership and related fuel demand are likely to jump twentyfold. In recent years, growth in private vehicles in China has averaged more than 23 percent.[1]

Background: The Global Energy Problem

The International Energy Agency (IEA) estimates that more than $4.3 trillion will need to be invested to meet the increase of 30 to 40 million barrels of oil per day the world will need beyond today's demand of 83 million barrels per day.[2] Fifteen percent of that added demand is projected to come from the United States alone and another 24 percent from China.

At the same time that fuel demand could take off in the developing world, gains in conventional oil supply within major oil consuming regions are also expected to slow. From 1970 to 2000, more than 40 percent of the increase in world energy supply came from within industrialized regions such as the United States, Europe, and Australia — or, more specifically, Alaska, the U.S. Gulf of Mexico, the United Kingdom, and the Norwegian North Sea. However, over the next 25 years, experts project that incremental new OECD oil supply will grind down to a trickle, representing less than 10 percent of new conventional oil supplies. Greater contributions in resources from OECD

(Organization for Economic Cooperation and Development) nations could come in the form of higher-cost, unconventional resources such as tar sands, oil shale, coal to liquids, and gas to liquids.[3] But exploitation of these unconventional resources may involve the release of higher amounts of greenhouse gases (GHG) than in the production of conventional oil and gas, creating political opposition to their widespread use.

World dependence on oil from the countries that are members of the oil cartel, the Organization of Petroleum Exporting Countries (OPEC), is likely to grow substantially as availability of non-OPEC oil fails to keep pace with increases in demand. But over the past few years, OPEC has been slow to respond to rising oil prices by bringing on additional supplies, even as prices reached $100 a barrel. OPEC governments, responding to pressing social and economic pressures of growing populations and aging infrastructure, now clearly favor the realization of greater short-term revenue, which will be best achieved not by bringing on line new oil production capacity, but rather by curtailing output.[4] OPEC rhetoric has matched its new focus and the producer group noted that its aim was to attain a "fair" price for its oil. The debate highlights the true nature of the geoeconomic issues underlying OPEC's relations with the rest of the world; at issue is an economic struggle for "rents" between oil producers who demand high revenues and major consumers whose economies can grow faster with low oil prices.

OPEC has also warned in recent years that a shift to alternative energy inside major oil consuming economies will discourage its own investment in future oil supplies, potentially forcing oil prices "through the roof." Speaking the day before a meeting of the G8 group of industrialized nations meeting in June 2007, OPEC secretary general Abdalla Salem el-Badri said OPEC was considering cutting its investment in new oil production: "If we (OPEC) are unable to see security of demand… we may revisit investment in the long term." He warned that the U.S. and European biofuels strategies would backfire because "You don't get the incremental oil and you don't get the ethanol," alluding to the fact that a biofuels strategy might not prove successful.[5]

If OPEC fails to bring on line major commitments of capital to increase its oil productive capability, the world will be more likely to face wider scarcity of fuel if demand grows as forecast, and new policies are not put into place in oil consuming countries. The problem is considered so severe that a few policy analysts are even predicting resource wars could develop as nations struggle against each other to secure increasingly scarce energy supplies.[6]

Moreover, security of existing supplies remains another key challenge in the shorter term. In the Middle East, exporters face greater risks from terrorist attacks following al Qaeda's 2004 call for attacks on regional oil facilities and infrastructure. Risks to navigation through the Strait of Hormuz have also increased in recent years following an increase in sea-based terror attacks and mounting international tensions with Iran over its nuclear program. Unfettered access to Russian energy supply is also problematic, as the Kremlin has shown a willingness to use energy as an economic lever to gain political ends. And civil unrest, heavy government interference in the energy sector, bureaucratic inefficiency, and corruption hinder the development of oil supplies in many countries in Africa and South America, and in some cases have disrupted immediate exports.

This changing outlook for international oil markets comes against a shifting balance of global power away from a U.S.-dominated system to a more multipolar world with numerous geopolitical and economic power centers. Not only are emerging economies of China and India becoming increasingly important, but the European Union (EU) has emerged as an important leader in international

relations and economic trends and an equal geopolitical partner as well as competitor to the U.S.-led world order.

The strong "green" agenda of the EU will greatly impact the kinds of fuels that will be accepted in Europe and is influencing global climate policy at an increasingly rapid rate. European trends are also driving global public and private political opinion in favor of more stringent restraints to greenhouse gas emissions is gathering momentum. U.S. policy makers are increasingly embracing strong ties with Europe and a greener focus is quickly gaining attention to American state and federal regulations and investment trends as well as culture and media.

The challenge to reduce the amount of greenhouse gas emissions from energy production and use is inherently an international problem. Continuing to burn fossil fuels at current or expanding rates will have deleterious impacts on the global climate. Martin Hoffert, professor of physics at New York University, argues in one seminal analysis that stabilizing the carbon dioxide-induced component of climate change is an energy problem.[7] He notes in a widely held view among scientists that stabilization will not only require an effort to reduce end-use energy demand, but also the development of primary energy sources that do not emit carbon dioxide (CO2) into the atmosphere.

Under a business-as-usual energy supply scenario, carbon concentrations in the atmosphere would rise to 750 parts per million (ppm) by the end of the century, a concentration level Hoffert's calculations show would melt the West Antarctic ice sheets and erode coastlines around the globe. In order to hold atmospheric carbon dioxide concentrations to 350 ppm by mid-century—the level targeted by environmental scientists as preventing catastrophic changes—at least 15 terawatts of non-fossil fuel energy (the equivalent of twenty times today's level of nuclear energy worldwide or double the amount of current world oil production) will be needed to reduce carbon dioxide levels to modest targets of 550 ppm by 2050. To reach the goal of 350 ppm, at least 30 terawatts would need to be derived from non-fossil sources. Thus, the challenge of restraining demand growth for fossil energy will be a monumental one.

This overwhelming array of problems poses a significant barrier to U.S. energy security just by the nature of the international landscape. However, by viewing the situation of the United States in international context, many possibilities to minimize this barrier appear in cooperating with other consumer nations, better utilizing reserves, diversifying energy sources, and through technological innovation.

The U.S. Energy Situation

Mirroring the international energy situation, the United States, as the world's largest energy consumer, is facing daunting energy challenges. Demand for oil has been rising steadily, but growth in supplies has not kept pace. The United States is the third largest oil producer in the world, but its production has been declining since 1970 as older fields have become depleted. The United States is now more dependent on foreign oil than ever before. It imported 12.3 million barrels per day (bpd) in 2006, or about 60 percent of its total consumption of roughly 20.7 million bpd. That is up from 35 percent in 1973. The share of imported oil is projected to rise to close to 70 percent by 2020, with the United States becoming increasingly dependent on Persian Gulf supply. U.S. oil imports from the Persian Gulf are expected to rise from 2.5 million bpd, about 22 percent of its total oil imports in 2003, to 4.2 million bpd by 2020, at which time the Persian Gulf will supply 62 percent of total U.S. oil imports, according to forecasts by the U.S. Department of Energy (DOE).

More than three decades after the 1973 oil crisis, U.S. supply of oil is no more secure today than it was thirty years ago. Moreover, its dependence on oil for mobility has never been stronger. All told, there are over 242 million road vehicles in the United States, or close to one vehicle for every person. Each vehicle is driven over 12,000 miles annually, and virtually all vehicles are powered by petroleum-based fuels, either gasoline or diesel. As a result, despite the fact that the United States accounts for only 5 percent of the world's population, it consumes over 33 percent of all the oil used for road transportation in the world. By comparison, China, even with its growing economy, has about 13 million vehicles and consumes only about 5 percent of all the road fuel produced in the world, despite having a population that is more than four times that of the United States.

Rising U.S. oil imports have been a significant factor strengthening OPEC's monopoly power in international oil markets. U.S. net oil imports rose from 6.79 million bpd in 1991 to 10.2 million bpd in 2000 while global oil *trade* (that is oil that was exported across borders from one country to another) rose from 32.34 million bpd to 42.67 million bpd. In other words, the U.S. share of the increase in global oil trade over the period was a substantial 33 percent. In OPEC terms, the U.S. import market was even more significant — representing over 50 percent of OPEC's output gains between 1991 and 2000.

Strong U.S. import demand not only enhances OPEC's monopoly power, it also has a deleterious long-term impact on the U.S. economy. The U.S. oil import bill totaled $327 billion in 2007 and is expected to top $400 billion in 2008.[8] This represents an increase of 300 percent from 2002. The U.S. oil import bill accounted for as much as 40 percent of the overall U.S. trade deficit in 2006, compared to only 25 percent in 2002. This rising financial burden is stoking inflation and creating ongoing challenges for the U.S. economy.

Future U.S. oil consumption is centered squarely in the transportation sector, which represents more than two-thirds of total petroleum use and will constitute over 70 percent of the increase in demand. From 1995 to 2006, U.S. gasoline demand grew on average about 1.7 percent per year, reflecting factors such as growing per capita income, low gasoline prices and a commensurate increase in less fuel efficient SUVs and other larger cars, and increasing urban sprawl.

But future U.S. oil demand growth is not the only concern. By the year 2020, Asian energy consumption is projected to account for over one-third of global energy use, rivaling that of North America and Europe and likely resulting in large increases in an already substantial dependence on imported energy. More than half of the future growth in energy demand in Asia is expected to come from the transportation sector where, barring a technological breakthrough, increased reliance on crude oil and crude oil products will be unavoidable. Per capita income growth in developing countries in particular, such as China, Malaysia, Thailand, India, and Indonesia, will account for an increasing proportion of energy demand by encouraging an increase in automobile ownership, and with it, a corresponding rise in motor fuel demand.[9]

To put this into perspective, total oil demand for Asia is already larger than that of the United States, and oil imports, which are already above 70 percent of total consumption, have risen substantially in recent years, up from about 11 million bpd in 1998. According to the business-as-usual scenario forecast by the International Energy Agency, oil demand in all of Asia is expected to grow two to three times faster than in the industrialized West. By 2010, total Asian oil consumption could reach 25 to 30 million bpd.[10]

Against this backdrop of rising U.S. and Asian oil demand and instability in the Middle East and other major oil supply areas, there are, in fact, many reasons to be concerned about a major supply disruption that could affect American mobility.

Supply risks include, among other things:

- The possible spread of conflict or instability from Iraq into other oil producing countries or the escalation of a proxy war involving Saudi Arabia, Syria, Turkey, and Iran over the outcomes in Iraq.
- A work stoppage or strike by oil workers, possibly motivated by political trends involving power sharing or human rights issues related to internal instability in a major oil producing country.
- A confrontation with Iran over its nuclear aspirations that results in sanctions against Iranian oil exports or an Iranian terrorist threat to oil shipping through the strategic Strait of Hormuz, through which 16 million barrels of Mideast oil pass each day.
- Al Qaeda or other terrorist attacks on oil facilities.
- Domestic unrest or political crises, ranging from a leadership succession problem to a radical revolutionary challenge to an existing regime in a major oil exporting country.
- A politically motivated cutoff of oil supplies by a major oil exporter or group of exporters.
- Destruction of oil production or fuel manufacturing infrastructure due to a severe storm or natural disaster.

The United States has no comprehensive strategy to deal with these kinds of long-term major supply risk challenges and perhaps worse still, some of the options available to lessen this risk could come at an expensive cost in terms of climate change mitigation.

The United States also has yet to forge a thoughtful response to climate change. In 2005, the United States emitted a total of 712 million metric tons of carbon, 412 million metric tons of which came from road petroleum use. The country emits more energy-related carbon dioxide per capita than any other industrial nation.[11] In the 1990s, the U.S. transportation sector represented the fastest growing emissions of carbon dioxide of all other major sectors of the U.S. economy.[12] The U.S. Department of Energy predicts that the transport sector will generate almost half of the 40 percent rise in U.S. carbon emissions projected for 2025.

The urgent need to reverse the growth path in U.S. fossil fuel use and related global warming pollution has opened debate about the risks and tradeoffs of various strategies. The United States is not negotiating from a position of strength when it comes to oil, and our ability to affect directly the dynamics of international oil supply is weak, as witnessed by U.S. President Bush's unheeded call on OPEC to increase oil supply in March 2008. OPEC responded by holding its oil output levels unchanged and criticizing the U.S. President for "mismanaging" the U.S. economy.[13] Unless it can forge a more effective policy response, the United States sits as a prisoner of policy choices being made by major oil producers and by the inefficiency of the national oil companies (NOCs) in many oil producing nations.

Some authors have even argued that future U.S. international power will be compromised by continuation of this oil dilemma. Michael Klare notes in his book *Resource Wars*: "No highly industrialized society can survive at present without substantial supplies of oil, and so any significant threat to the continued availability of this resource will prove a cause of crisis, and, in extreme cases, provoke the use of military force."[14] Nader Elhefnawy takes the argument a step farther, asserting that since the U.S. economy is the

most oil dependent among world powers, "the United States could ultimately lose its position as a world power…just as the UK's position declined along with the age of coal and steam that it (the UK) pioneered."[15]

Consuming Country Power

As discussed above, the United States is a major buyer of imported crude oil and its imports represent a large share of the market for internationally "traded" oil. Given the large scale of U.S. purchases, incremental U.S. acquisitions of oil affect its overall international market price. Stated another way, the cost of each marginal barrel is higher than the price paid for that barrel since this additional purchase affects the costs of all oil consumed. From the perspective of the United States, this constitutes an externality.[16]

On the other hand, the fact that the United States faces a rising supply curve for oil gives it "monopsony" power. To the extent that the United States — or a group of consuming countries including the United States or of nations of comparable scale — takes concrete actions to reduce the size of its purchases, it can lower the market price of oil.

It has been well established that OPEC frequently changes its price targets in response to changes in market demand. Discussion of the size of a monopsony-power wedge that is the "difference between the current price of oil and the marginal cost of adding a barrel of demand" was the subject of Stanford University's Energy Modeling Forum and other exercises.

OPEC's response to efforts by the Organization of Economic Cooperation and Development to reduce oil demand has varied over time. Initially, as OECD demand receded in the 1980s, OPEC maintained its output path, letting oil prices decline. This produced the biggest buying-power wedge size and reinforced the viability of consumer country policies that sought to exercise this monopsony power. However, in recent years, OPEC has been preventing its supply from growing in line with demand and thereby maintaining a more preferential price path.

Consuming countries have implemented two key approaches to dealing with OPEC given the increasing trend towards oil price deregulation inside the OECD. First, governments have organized to hold strategic stocks of oil. And second, some governments have imposed or increased consumer taxes on oil, which reduces demand. This strategy has been implemented in Europe and Japan, where oil demand has been relatively flat for several decades.

In a deregulated market setting, government takes a role in ensuring adequate oil inventories are on hand to maintain orderly markets and to counter the temptation of suppliers with monopoly power from taking advantage of short-term tightness in oil markets. To achieve these ends, government-held stock levels must be credible to convince oil producers that efforts to exploit temporary market tightness by further cuts in production to achieve even higher oil prices will not be successful. Such attempts to extract additional rents from consuming countries would be countered by the release of sufficient inventories to offset any cuts in production contemplated by producers.

The larger the government-held stocks and the more consuming governments that participate in such stock holding programs, the more effective it is likely to be in serving as a deterrent to OPEC's monopoly power in deregulated markets.

In addition, some consuming country governments have been able to reduce the negative effects of price variability by increasing energy efficiency and reducing dependence on oil through the use of hefty consumer taxes. The net effect of such taxes is to discourage a wasteful use of energy by

consumers and at the same time collect some of the rents that would otherwise accrue to oil producers. Furthermore, large oil consumption taxes, as discussed above, can force OPEC to accept lower prices, as happened throughout most of the late 1980s and 1990s.

When OPEC's monopoly power strengthens due to short-term market tightening, the incentive to exploit that power is tempered by the fact that increases in monopoly rents will not accrue entirely to producers, but will be shared with consuming countries that have high energy taxes.

The burden of rising energy import costs threatens social stability in such key consuming countries and regions as India, Pakistan, and Southeast Asia. Moreover, supply constraints also make it easier for governments or sub-national groups to threaten vital interests of the United States and OECD countries and their allies.

Thus, consuming countries have a clear interest in undertaking policies that will undermine both OPEC's short-term and long-term ability to act as a cartel to inflate oil prices. Policies taken in conjunction with other consuming nations are likely to be more effective than policies taken individually by increasing the strength of the monopsony wedge.

Toward a U.S. Diplomatic Strategy with Other Important Consumer Countries

At the present time, oil producing nations are able to play consumer nations off of each other to enhance their regional and global power. In doing so, producers have been able to extract higher rents (economic and political) from major consuming countries such as the United States, China, India, and Japan. Countries like Burma and the Sudan have been able to stave off international pressures for intervention and compliance on human rights crises by feeding competition for stakes in their energy resources among China and India. Russia has pitted Japan and China in a competition for East Siberian resources, fueling tensions between the two consumer countries and gaining preferential terms for financing infrastructure projects and trade. Populist Venezuelan President Hugo Chavez has tried to bolster his positions against U.S. interests by seeking Chinese involvement in Venezuela's oil industry. Iran's regime has threatened to interrupt oil exports via the vital Strait of Hormuz if the United States and its allies impose sanctions against Tehran for its pursuit of nuclear weapons.

If the United States is going to redress this pursuit of oil rents and shifting in the balance of power in the global community, it must build a coalition for active cooperation among oil consuming nations. The United States has not made this a high enough priority of its international diplomacy. Technical-level meetings have been ongoing between the United States and various countries on energy cooperation and the International Energy Agency has pursued dialogue with various major consuming countries on stockpiling coordination and alternative energy, but no high-level dialogue has been established.

The focal point for a high-level U.S. dialogue with other consuming countries should begin with China. The U.S.-China bilateral agenda is a crowded one, but certainly the Middle East and energy policy need to be moved higher up on the list of topics for high-level meetings. So far, U.S.-China energy cooperation is handled at a technical level. Political escalation of dialogue would have definite benefits.

One idea is to have such a dialogue led by the U.S. vice president, much the way Al Gore and Viktor Chernomyrdin discussed U.S.-Russian energy cooperation in 1990s, paving the way for U.S.-Russian joint investment in major energy projects. Another possibility is to appoint a senior U.S. diplomat with energy experience to serve in a new post as an energy diplomacy liaison to Beijing to

jumpstart more proactive and ongoing policy coordination and new energy initiatives between the two countries. The endgame should be the development of a harmonized energy policy that could enhance the leverage both countries would have in dealing with muscle-flexing oil producing nations. Reaching energy strategy collaboration with China would also pave the way for broader coordination on global warming policy, removing a key barrier to U.S. political agreement to a post-Kyoto international accord.

Chinese policy makers and the Chinese public are increasingly becoming worried about climate change. At the first meeting of the national work group for climate change and energy conservation and emission reduction in July 2007, Chinese Premier Wen Jiabao emphasized that his administration recognizes the urgency of "energy-saving and pollution reduction" and he called for higher priority to environment and climate change programs.[17] Extreme climate events, drought, and sea level rise are among the impacts that are already being faced in China.[18] One poll, the Global Environment Review, found that 87.6 percent of Chinese surveyed were concerned about climate change and 45.6 percent expressed a deep concern. In addition, 90.8 percent of interviewees cared about the impact of climate change on children and 96.6 percent of interviewees deemed that the Chinese government should take more measures to tackle global warming and climate change.[19] Another poll conducted by the Social Investigation Centre of Chinese Youth Newspaper and the News Centre of Tencent showed that 84.6 percent of 4,834 interviewees thought global warming should be regarded as an urgent issue not only in China but for the entire world.[20]

However, polling conducted by Rice University's Shell Center for Sustainability's Coastal Cities project shows that 70 percent of Chinese respondents from Shanghai, Shenzhen, and Tianjin and over 75 percent of Americans surveyed from Houston, Los Angeles, and New York believed that sea level rise did not pose a serious problem for their city. Even in the face of the 2005 hurricanes, Rita and Katrina, only 33 percent of Americans surveyed by Rice University considered severe storms and flooding to be a serious challenge for their municipality while it was over 40 percent for the Chinese respondents. Still, more than 80 percent of the Americans surveyed in Houston, Los Angeles, and New York believed that normal activities, such as driving cars and running air conditioners, contribute to harming the environment, in addition to the 56 percent of the Chinese polled in Shanghai, Shenzhen, and Tiajin who felt this was the case.[21]

According to the Chinese Initial National Communication on Climate Change,[22] China's total GHG emissions in 1994 were 4.06 billion tons equivalent, of which 3.07 billion tons were CO_2. Total GHG emissions in 2004 were about 6.1 billion tons equivalent, of which 5.05 billion tons were CO_2. The annual growth rate from 1994 to 2004 was averaged around 4 percent, and the CO_2 in total GHG emissions increased from 76 percent to 83 percent (See Figure I).[23] Widespread use of coal in China's economy — 67 percent of primary energy consumption — is the major contributor to its GHG profile. China's initial attempts at energy savings laws resulted in an annual average rate of energy intensity decrease by 5.32 percent from 1980 to 2000. Recognizing the energy challenge, China also passed a national fuel efficiency standard in 2004 that was implemented in two stages: the first stage began in July 2005 and the second in January 2008. Although U.S. standards for fuel economy are stricter for small cars, Chinese standards are more aggressive in curbing heavy vehicles, including SUVs, and there are plans to tighten all standards in the future.

A deal with China could serve as a model for similar synchronization with the EU, Japan, India, Brazil, and South Korea.

Among the policy options that could be part of the consuming country dialogue are:

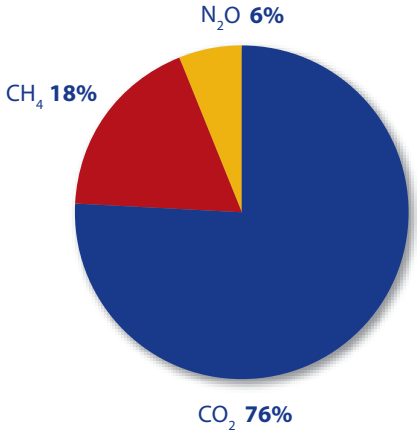
1. Expansion and restructuring of the IEA to better reflect the change in consumer country demand trends.
2. Promotion of greater investment in diverse non-OPEC oil resources.
3. Rapid development and deployment of alternative energy technology, especially advanced automotive technologies such as plug-in hybrid vehicles.
4. Coordination on development of federal policies and technology transfer to enhance energy efficiency.
5. Maintenance or expansion of taxes on oil and gasoline.
6. Coordination of climate strategies, including harmonization of cap and trade and other carbon management policies.

Emergency Stockpiling Systems

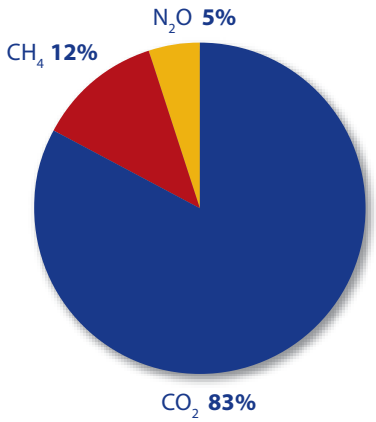
The International Energy Agency (IEA) was created a quarter of a century ago as a mutual-protection society of OECD countries. Designed as a political grouping to prevent any oil-producing countries from using oil exports as a political instrument to influence the foreign policies of IEA members, the IEA was formed at a time when the OECD countries dominated global energy consumption. Today it excludes the most rapidly growing energy-consuming countries in the world—China, India, and Brazil among them. And, as a result, these new consumers are becoming more vulnerable economically in times of disruptions as well as vulnerable potentially to political pressures from oil producers.

In recent years, there has been discussion about increasing the number of member countries inside the IEA, and South Korea has joined the organization. Other countries such as China and India are creating national strategic oil stockpiles but these stockpiles remain small to date and the policy

COMPARISON OF CHINA'S GHG EMISSION COMPONENTS FROM 1994 AND 2004



Components of GHG Emissions in 1994



Components of GHG Emissions in 2004

framework for using them is still under development and hasn't been tested. The IEA has invited both China and India to participate as observers in meetings for several years and is pursuing options for finding mechanisms for major non-IEA oil consuming countries to participate in joint stockpiling emergency programs, but so far to no successful outcome.

The extent of effectiveness of the IEA system, however, will depend on oil market developments, including Asian demand trends. The member countries of the IEA now represent a smaller portion of the oil market than they did at the time of its formation in 1977. As oil demand growth in Asia expands in the coming decade, new strains could come to the international system if new policies are not put in place. The omission of key consumer countries from Asia into the global emergency stockpiling system will increasingly put pressure on the effectiveness of limited, existing stocks in OECD countries. Moreover, tensions created by Asian "free-riding" or possible "hoarding" actions during a crisis could hinder the IEA's ability to stabilize international oil markets in the future.

The OECD countries comprising the IEA represented 42.3 million barrels per day out of a total world oil use of 60.6 million bpd in 1977, or around 70 percent of world oil demand. The United States alone consumed 30 percent of the world's oil used in 1977. Asia Pacific demand at that time was a less critical component to the world oil use situation at 10.1 million bpd, or roughly 16 percent of world oil demand.

By 2006 the OECD share of world oil use declined to 58 percent of total world demand while Asia Pacific use had grown to 29 percent, overtaking the U.S. share of 24 percent. Asian economic powers Japan, South Korea, Australia, and New Zealand are OECD members and, as such, are part of the IEA system now. But other key Asian oil consumers such as China, India, Taiwan, Thailand, Philippines, and others are not. As their share of world oil demand grows, this disconnect between Asia's size and importance as a consumer region and its lack of energy policy coordination with other large oil consuming countries (and/or the International Energy Agency) will create new problems and challenges for international oil markets and the international economic system. In particular, it is important that large Asian consuming countries not purchase and "hoard" oil during an IEA stockpile release because this activity would reduce the effectiveness of a stock release to calm markets and prevent oil supply shortages. The best possible win-win scenario would be for new links between the IEA and other large consumer countries or consumer country groups.

The larger the government-held stocks and the more consuming governments that participate in such a stock holding program, the more effective it is likely to be in serving as a deterrent to OPEC's monopoly power in international markets. Moreover, it is in the United States' national interest that important emerging oil importing countries such as China and India do not become potentially vulnerable to political pressures of oil producers and thereby favor policies that are adverse to the U.S. interest or the interests of all oil consuming countries.

The mere existence of the IEA stockpiling system has also served as a restraining force in the deliberations of OPEC. In the 1990s, OPEC on several occasions opted to make its own incremental supplies available. This policy reflects not only goodwill but self interest since any OPEC failure to put extra oil on the market following a sudden, unexpected supply shortfall might invite a release of IEA stocks, leaving consumer governments to profit from any extra oil sales rather than OPEC.

The willingness to use strategic stocks, especially if done so in a coordinated fashion with other large consuming countries, creates an alternative supply to lower the price of oil, thereby preventing or blocking an oil exporting country or group of countries from hurting consuming countries by cutting off or reducing oil supplies. The existence of strategic stocks raises the costs for an oil producing country to attempt to use oil supply opportunistically as a political or economic weapon, as it would have to restrict its exports by a larger amount for a longer period of time before having an impact on its target; in the immediate term any shortfall that it could create could be offset by a coordinated release of consumer stocks.[24]

In the case of an accidental or unexpected oil supply disruption, consuming country willingness to release strategic stocks also reduces the chances that oil producing countries will fail to replace supplies by utilizing spare production capacity. If higher oil revenues from such a disruption will go either to oil exporters with spare capacity or to consuming governments who sell oil from strategic stocks, producers have more incentive to put extra oil onto the market and grab temporary rents for themselves (instead of ceding them to consuming governments) since some amount of replacement oil will be made available in either case. In such a case, oil exporting governments have the political cover that supply increases are being granted to ensure that oil revenues accrue at home instead of being ceded to other nations, rather than the harder case that supply increases are being made to help the economies of other nations. In an age when anti-American sentiment is prevalent in the Middle East, this distinction can be important because many regimes would not want to be seen as aiding the United States at the expense of higher domestic revenues that could be shared among their domestic constituencies.

In recent years, consuming countries have not been effective in tapping the leverage of strategic stocks in negotiating with OPEC about its responses to supply disruptions or tightening markets. The Bush administration, by making clear its intention to use strategic stocks only under a narrow range of circumstances in an emergency related to war, has weakened the leverage that could have been gained from a more flexible management of IEA strategic stocks. In 1990, the United States proactively negotiated for OPEC to respond to the sudden loss of oil from Iraq and Kuwait by proposing a combination of a joint release of strategic stocks and an increase in output by OPEC to stabilize oil markets. The Clinton administration also used this tool to cap oil prices at $40 a barrel, by signaling to oil markets and OPEC that it would use a “test sale” from the U.S. strategic petroleum reserve to calm oil markets and discourage speculative activity during a disruption or severe imbalance of markets. But the administration of George W. Bush, by signaling to oil markets and OPEC that it would not use the strategic petroleum reserve to calm markets or ease prices under any circumstances except major wartime supply shortfalls, gave free rein to speculators and OPEC to manipulate oil prices upwards, without fear of repercussions and revenue losses from a surprise release of U.S. or IEA strategic stocks. The unintended consequence of this Bush administration policy has been to unwittingly drive upward pressure on prices and market manipulation by OPEC.

A high-level strategic dialogue with other large consuming countries — one that demonstrated the existence of a strong consensus system to utilize strategic stocks in protecting joint consuming country interests — would strengthen the U.S. bargaining position vis-à-vis OPEC when the United States feels it is in its interests or the interests of the global economy to press OPEC to provide more oil. It would also reduce the vulnerability

of any particular consuming nation to energy "blackmail" by one of its major oil suppliers. The creation of strategic stocks of natural gas might be a useful tool, for example, in protecting European allies against the threat of an energy supply cutoff by Russia.

However, strategic stocks only offer a temporary stopgap measure to constraining monopoly power of a producer or group of producers. The use of strategic stocks will not be effective as a permanent deterrent of a "persistent OPEC strategy to restrain production."[25] The development of alternative energy and energy efficient technologies can prevent producer cartels from exacting monopoly profits by promoting alternatives that reduce the need for fossil fuel. In a context where oil suppliers might be inclined to use oil as a lever to political ends, energy security could be redefined as reducing the vulnerability of the economy to the reduction or cutoff of oil supplies from any given supplier or group of suppliers or to sudden large increases in prices of specific energy commodities such as oil and natural gas. To do so, the consuming country must increase its elasticity of demand for that commodity by increasing the flexibility of energy-using industries or transport vehicles to shift amongst alternative fuels and by both lowering the oil intensity of its economy and increasing the diversity of alternative oil suppliers and the shares of alternative fuels and energy sources in its mix of primary energy use.[26]

Diversification of Oil Supply

From an energy security point of view, consuming countries benefit when global oil production comes from as diverse a base as possible. Such diversity reduces reliance on any one particular country or geographic center, thereby lessening the potential for a large-scale disruption from any one area. As discussed earlier, increased reliance on a handful of Middle East oil producers also enhances the potential for the exercise of monopoly power, especially during times of supply shortfall or disruption. When oil supplies exceed demand by a substantial measure as a result of large gains in non-OPEC oil development, it mitigates the impact of a loss of output from any particular location.

Political, legal, economic, and geographical constraints currently block development of vital resources in several oil rich countries in the competitive fringe outside of OPEC. Active policies that attempt to use bilateral influence, aid, conflict resolution assistance, and other diplomatic leverage to remove some of the barriers to investment and technology transfer to oil producers in Indonesia, Central Asia, Russia, Asia, and Africa could dramatically reduce the pressure on oil markets in the years to come.

The United States and other large consuming countries, banded together, can do a great deal more to enhance the institutional mechanisms that favor markets over political intervention by producers. Much international economic architecture already exists to try to influence this process, including the WTO trade and investment rules, free trade agreements, the Energy Charter, and other multinational agreements. In some cases, energy has been exempted from these agreements in response to the pushback of resource nationalism, but such exceptions should be more strongly resisted. Access to consuming country markets and preferential trade status should be linked in some measure to oil producing states' energy sectors delivering more liberalized policies towards investment in its resources.

The United States needs to show leadership by looking seriously at ways to bring the rules of global oil trade and investment in harmony with the rules governing trade in manufacturing and services. This would mean building on open trade and investment within the IEA and discriminating actively against those countries that do not permit foreign investment in their

energy resources and that limit their exports to manipulate prices. This is a tough policy, but one that could be effective in countering OPEC's rising influence. Liberalization and open access for investment in all international energy resources would mean their timely development rather than today's worrisome delays. Without global norms across the oil world, the world experiences capital- and politically-constrained limitations of supply that cripple the global economy today and perpetuate poverty in the energy-poor countries of Africa and Asia.

For starters, it should be in the U.S. mission to promote best practices for NOCs through existing and emerging bilateral and multilateral trade mechanisms such as the World Trade Organization, the Energy Charter, NAFTA, and other similar international architecture.

The case of Norway's Statoil is instructive to this point. For Norway to join the European Economic Area (EEA), in which Norway would receive access to the common market, it was forced to follow common competition directives. Before EEA entered into force, Norwegian oil and gas companies constituted a monopolist sales organization that regulated marketing and sales of Norwegian gas into the continent. This meant that Statoil, as the controlling party, was able to act as a monopolist and set natural gas prices and contract customers for all long-term sales of gas from the Norwegian Continental Shelf. With entry into force of the EEA this changed, as Norway had to mirror the European commission in the "fields of competition, state aid and public procurement." This affected Norwegian oil policy in two important respects. First, it meant that the state lost its ability to direct companies' investments and expenditures. Second, as this occurred in tandem with the first steps to liberalize European natural gas markets, it meant that Statoil had to give up its monopoly power of gas sales to the European Union. But in fact, the post EEA fate of Statoil has not been to disband the company because without its monopoly benefits, it cannot serve its purpose to Norway. If anything, Statoil is likely to be able to continue to grow, providing higher returns and augmentation to the Norwegian government's remaining shareholding. Statoil's future still looks bright, but the EU's insistence that Norway join the club without making an exception for its national oil company ensured that Statoil promoted transparent and competitive practices, permitting the firm to make efficient investments in future production capacity.

The Norwegian example highlights an excellent opportunity that could be gained by using multinational mechanisms such as the WTO, the Energy Charter, and free trade agreements to foster more transparent and competitive commercial practices inside major oil producing countries and enhancing more open access for investment in resources currently blocked by these countries' monopolistic, bureaucratic, and nationalistic internal trends.

Alternative Energy and Energy Efficiency Technology

Increasingly, consumer governments are discussing enhancing the development of backstop technologies or promoting alternative energy sources that can serve to reduce the need for fossil fuel. In this practice, backstop technologies create an incentive for oil producers to avoid oil price shocks and supply disruptions for fear that the new technologies would be released and utilized, permanently eliminating sales markets. Alternative energy supplies provide ready substitutes if the price of oil rises too extremely and can shield the economy from the negative impact of disruption from any one fuel source.

The deployment of improved car technology could have a dramatic effect on future oil demand trends as well as play a major role in lowering CO_2 emissions by advancing fuel efficiency. For example, the benefits of energy efficiency in

protecting the domestic Japanese economy from oil price variability are well known. Japan did not experience a severe recession after the 1979-1980 price shock, whereas the United States, the United Kingdom, and Germany, which were less energy efficient at the time, did experience painful losses in economic output.[27]

The expansion of nuclear power in the 1970s is an excellent example of how alternative energy can reduce vulnerability to oil producer monopoly power and oil price shocks. The Baker Institute studied the economic savings, in terms of higher macroeconomic output in times of energy price volatility, associated with the development of nuclear capacity in Japan. More specifically, by developing an econometric model relating output to energy price fluctuations, the study attempted to quantify the energy security value of nuclear power generation in Japan. By examining past episodes of energy price volatility, we were able to simulate the magnitude and probability of sudden cost increases or supply shortages of imported oil and gas and the damage that can come to the Japanese economy from such price increases or supply disruptions, including loss of GDP.[28]

The Baker Institute study found that there is a clear energy security value for nuclear power in Japan. Nuclear power can provide more stable fuel costs as oil prices vary because uranium prices are only very weakly correlated with oil prices. By contrast, both natural gas and coal prices are much more closely linked to oil prices. By stabilizing price fluctuations, a greater proportion of nuclear fuel in the primary energy mix can then protect overall national economic performance during times of disruption. The study shows that a broad mix of fuels, including nuclear power, has helped Japanese consumers enjoy lower and more stable electricity costs than would have been possible without it. In summary, the Baker study concluded that diversity of fuel sources increases flexibility to keep overall costs low during sudden or prolonged disruptions. Having alternative choices also helps keep costs low in the face of more normal day-to-day fluctuations in fuel prices.[29]

It has been shown that the lower a country's energy consumption to GDP ratio or the shorter the period that oil prices will remain higher, the lower the cost of the tradeoff between inflation and GDP loss. New technologies exist on the horizon that could allow more gains in energy efficiency. Such technologies include micro-turbines for distributed power markets, improved car technologies, and household solar technologies, among others. OECD governments should encourage the deployment of these technologies into the marketplace through tax incentives or other vehicles in an effort to reduce their individual exposure to OPEC's monopoly power. A coordinated strategy of research and development and deployment among large consuming nations would be even more effective than singular national strategies and could be a major prong to an effective U.S.-China high-level energy dialogue.

Cooperative international research and development can lay the groundwork for technology breakthroughs in clean, distributed energy sources that can benefit rural populations in the developing world as well as lower GHG emissions throughout the globe. Such research should be aimed at revolutionizing advances in solar-derived fuel, wind, clean coal, hydrogen, fuel cells, and batteries and a new electrical energy grid that can tie all these power sources together. Such a research effort, led by the industrialized world, would yield benefits for all peoples both in reducing energy poverty and promoting global environmental protection. The United States should take a leadership role in this effort and look for important partnerships, including emerging consumers like China and India.

Energy Taxes Versus Energy Subsidies

Large consumer countries can divert rents away from OPEC and curtail its monopoly power to charge higher prices by imposing consumer taxes on domestic oil and gasoline consumption. Such taxes can also be used to influence consumers to show preference to cleaner fuels and to promote energy efficiency.

In dealing with OPEC, Japan and the EU should not show a willingness to remove or reduce domestic consumer taxes on oil. Consuming countries should work together to force OPEC to lower its own rents if OPEC desires to sustain or expand its market share for oil. The United States should reconsider its own position on energy taxes and look to harmonize its policies more fully with other consuming countries.

Some large consuming countries are still subsidizing fuel prices to consumers, and this practice is also something that could be addressed in a consumer country dialogue. Fuel subsidies are also a key factor influencing future export volume trends for many of the largest oil exporting countries. Fueled by large consumer subsidies, the Middle East Gulf has become the second largest region of growth in oil demand after Asia, with consumption rising by more than 5 percent a year since 2003 — similar to growth rates seen in recent years in China. The Middle East Gulf's demand for oil now represents over 7 percent of total world oil demand, with increases driven by economic expansion, high population growth, and extremely large subsidies to electricity and gasoline prices.

A recent report of CIBC World Markets calculated that "soaring rates of consumption in Russia, in Mexico and in member states of the Organization of Petroleum Exporting Counties would reduce crude oil exports by as much as 2.5 million barrels a day by the end of the decade."[30]

The issue of cheap and available fuel is a political hot potato inside OPEC countries. Many OPEC countries view their oil industry as a vehicle to achieve wider socioeconomic objectives, including income redistribution and industrial development. Among the noncommercial objectives imposed on national oil companies inside OPEC by political interests, subsidizing domestic fuel in an effort to redistribute oil proceeds to the general public and to promote economic development has been among the most debilitating policies to their long-term economic future. On a macroeconomic level, low petroleum product prices can stimulate growth in energy intensive sectors and limit incentives for energy efficiency, which in high-population societies only exacerbates the budgetary problems faced by the national oil company and the government. This problem creates a treadmill effect where the subsidies serve as a drain on the budget of the government and the NOC, leaving fewer and fewer funds to reinvest in expanding oil production over time as internal oil demand grows. At the extreme, the combination of rising oil demand and flagging domestic production following investment constraints can reap political and economic crises. OPEC member Indonesia flipped from a net oil exporting country to an oil importing country in the last three years because of flagging oil production in aging oil fields combined with soaring demand driven by fuel subsidies. Those fuel subsidies, which by the late 1990s had reached almost one quarter of the Indonesian government's entire federal budget, caused such massive economic dislocation for the Indonesian government that the longtime rule of President Suharto was ended as a result.[31]

Oil subsidies are propelling huge rises in oil demand in many developing nations and contributing to a tightening of the market and a strengthening of OPEC's monopoly power. The subsidies are also a factor contributing to severe economic problems within oil producing nations.

Thus, it is in the U.S. interest to work bilaterally and in tandem with international institutions such as the International Monetary Fund to help oil states to liberalize domestic energy markets and begin to foster energy efficiency by easing subsidy programs, and replacing them instead with more sound fiscal policies and less distortionary social welfare programs to aid the poor in their countries.

Moving the U.S. Economy to be Less Carbon Intensive

The strong green agenda of the EU will greatly impact the kinds of fuels that will be accepted in Europe, and it is influencing global climate policy at an increasingly rapid rate. Following proactive lobbying for intervention in this area by media and nongovernmental organizations, global public and private political opinion is moving more rapidly in favor of more stringent restraints to greenhouse gas emissions. A major change in how fuel is used and taxed can be expected in the next two decades, with the possibility that the United States could move back to a global leadership position in this area. The United States is currently transitioning from a detractor of global climate policy to a leader of energy technology innovation and a stronger advocate of global greenhouse gas emissions controls. U.S. policy makers are increasingly embracing renewed ties with Europe and a greener focus is quickly gaining attention to American state and federal regulations and investment trends as well as culture and media.

Two thousand and seven was a watershed year for federal energy and climate change legislation, and analysts believe the pace of deliberations on climate legislation will hasten after the U.S. 2008 presidential elections.

Across the United States, individual states and localities have enacted their own climate change policies, often in support of binding emissions targets, renewable energy programs, and collective action, such as carbon credit trading schemes. For instance, as of February 2007, twenty-three states had enacted highly varied renewable energy portfolio standards while another fourteen were considering legislation to implement a renewable energy standard.[32] U.S. industry leaders believe that significant climate legislation will be passed in the United States within the next two to three years and have begun to enter the debate about what form that regulation should take.

However, moving the U.S. economy to be less dependent on carbon intensive fossil fuels such as oil and coal can only be achieved in cooperation with other countries. By virtue of the nature of the global accumulation of greenhouse gas emissions in the world atmosphere, solving the problem of global warming represents one of the most difficult collective action problems in the modern history of international relations. Forging an effective U.S. climate policy will require the cooperation of major GHG emitters to prevent the so-called leakage problem where carbon intensive industries leave the more highly regulated countries and set up operations in a country with less stringent carbon restrictions. This will involve cooperation not just with China and India, major economic forces of the future, but also countries in the Persian Gulf that have been soliciting joint ventures in energy intensive, high carbon emitting industries such as aluminum and petrochemicals.

Emissions from the burning of gasoline and other liquid fuels constitute more than one-third of all global emissions stemming from fossil fuel combustion. Thus, addressing the fuel efficiency issue or reducing automobile use would be effective means to lower greenhouse gas emissions and harmonization of automobile efficiency standards and cooperation of research and development in this area could be highly productive in moving the needle to better outcomes on global greenhouse gas emission trends.

However, over half of the projected increase in global greenhouse gas emissions will come from the operation of new power generation facilities, mainly using coal and many of which will be located in China and India, according to projections from the International Energy Agency. Thus, the ability to generate electricity more cleanly in these two countries will be a critical aspect to a successful international climate accord.

Conclusion

The United States faces a serious challenge in addressing the barriers to energy security formed by global problems such as monopoly leverage from producing nations, global climate change, international market distortions, growing world energy demand, and by its own policies of inefficiency and low prioritization of international cooperation on energy issues. Luckily, through working to undo negative domestic policies and through new diplomatic and foreign policy approaches, the nation can rise to the challenge.

ENDNOTES

[1] Research shows that as per capita income rises between $5,000 and $12,000, vehicles stocks per person in a developing nation can increase by as much as a factor of 20. For example, in a country where there are 25 vehicles per 1,000 people, as income rises above $5,000 per capita, vehicles stocks will increase to 500 vehicles per 1,000 people. This correlation is important because many nations, including China and India, are experiencing per capita income increases to this critical "launching point" for car ownership. There is a tremendous potential demand for energy use as the global economy expands. Per capita primary energy use in the developing world remains markedly lower than the industrialized West, with India's total primary energy consumption per person averaging roughly 0.38 tonnes of oil per person in 2006, China's at 1.29 and Brazil's at 1.09, compared to the United States average of 7.79 tonnes oil per person and Germany at 3.98. See Kenneth Medlock and Ronald Soligo, "Economic Development and End-Use Energy Demand" *The Energy Journal* Vol. 22, No. 2 (2001); and Kenneth Medlock and Ronald Soligo, "Automobile Ownership and Economic Development — Forecasting Motor Vehicle Stocks to 2015" *The Journal of Transport Economics and Policy* (Spring 2002).

[2] International Energy Agency, "World Energy Outlook," (Paris, 2007).

[3] International Energy Agency, "World Energy Outlook," (Paris, 2006).

[4] There is a rich literature on the subject of the tradeoffs between volume and price with respect to OPEC revenue. The most recent contributions to these debates are found in Dermot Gately's recent pieces in the Energy Journal. See H.G. Huntington and Dermot Gately, "Crude oil prices and US economic performance: Where does the asymmetry reside?" *Energy Journal* Vol. 19, No. 4 (2002): 19-55; "How Plausible is the Current Consensus Projection of Oil Below $25 and Persian Gulf Oil Capacity and Output Doubling by 2020?" *Energy Journal* Vol. 22, No. 4 (2002): 1-27; and "OPEC's Incentives for Faster Output Growth," *Energy Journal* Vol. 24, No. 2 (2003).

[5] Javier Blas and Ed Crooks, "Drive on Biofuels Risks Oil Price Surge" *Financial Times* (5 June 2007).

[6] The concept, first introduced by Michael Klare in his book *Resource Wars*, theorizes that "diminishing supplies of vital materials" will raise the risk of conflict across the globe and "introduce new stresses into the international system."[6] Klare notes in his book: "No highly industrialized society can survive at present without substantial supplies of oil, and so any significant threat to the continued availability of this resource will prove a cause of crisis, and, in extreme cases, provoke the use of military force." Nader Elhefnawy takes the argument a step farther, asserting that since the U.S. economy is the most oil dependent among world powers, "the United States could ultimately lose its position as a world power. . . just as the UK's position declined along with the age of coal and steam that it (the UK) pioneered."[6] Authors Mary Kaldor, Terry Lynn Karl, and Yahia Said try to define the mechanism for how oil scarcity might lead to conflict in the volume "Oil Wars." They ask the question: "To what extent does oil cause, exacerbate or mitigate conflict, and what are the specific mechanisms through which this occurs?" Kaldor and her co-editors contend that the nature of war has changed and with it, the nature of conflicts over oil. Referring to the two World Wars and the Cold War, the authors note: "In these wars, oil was considered a key strategic commodity and security of oil supplies could be achieved only through the direct military control or territory or the exercise of influence over the generally authoritarian rulers of exporting countries."[6] They suggest that new wars are "associated with weak and sometimes ungovernable states. . ." where "the monopoly of organized violence is being eroded" and the "massive rents from petroleum are used in myriad ways to finance violence."

[7] Martin Hoffert, Ken Caldeira, Gregory Benford, et al., "Advanced Technology Paths to Global Climate Stability: Energy for a Greenhouse Planet" *Science Magazine* Vol. 298, No. 5595 (1 November 2002): 981-987.

[8] "U.S. Import Bill Set to Top $400 Billion," *Petroleum Intelligence Weekly* (10 March 2008).

[9] Kenneth Medlock and Ronald Soligo, "Economic Development and End-Use Energy Demand" *The Energy Journal* Vol. 22, No. 2 (2001).

[10] Energy Intelligence Group (EIG) Oil Market Intelligence data base, by subscription (July 2001); International Energy Agency, "World Energy Outlook," (Paris, years 1998, 2001, 2004, 2005, 2006).

[11] Byrne, Kristen Hughes, Wilson Rickerson, and Lado Kurdgelashvili, "American Policy Conflict in the Greenhouse: Divergent Trends in Federal, State, and Local Green Energy and Climate Change Policy" *Energy Policy* Vol. 35 (2007): 4555-4573.

[12] Joseph Romm, "The Car and Fuel of the Future," *Energy Policy* Vol. 24 (2006): 2609-2614.

[13] Jad Mouawad, "OPEC blames 'mismanaged' US economy for soaring oil prices" *International Herald Tribune* (6 March 2008).

[14] Michael Klare, *Resource Wars* (New York: Henry Holt and Company, 2001).

[15] Nader Elhefnawy, "The Impending Oil Shock" *Survival* (June 2008).

[16] See study by D.R. Bohi and M.A. Toman, *The Economics of Energy Security* (Boston, MA: Kluwer Academic Publishers, 1996): 14-15 and 44-45.

[17] See http://www.ndrc.gov.cn/rdzt/jsjyxsh/t20070712_147751.htm (accessed 04/02/2008).

[18] For a survey of China's positions and policy, see Xiaojie Xu, Yoon Jung Kim, and Dongchao Li, "Chinese Policies on Climate Change and Environment Protection," forthcoming in May at www.bakerinstitute.org.

[19] It is available online in Chinese at http://money.163.com/07/0619/15/3HC3JDE1002525CK.html (accessed 04/02/2008).

[20] It is available online at http://cn.chinagate.com.cn/environment/2007-06/11/content_8369330.htm (accessed 04/02/2008).

[21] See Rice University, "Coastal Cities: Crisis in the Making?" Shell Coastal Cities Project.

[22] This document was published by the Chinese government in 2004, available online at http://www.ccchina.gov.cn/en/NewsInfo.asp?NewsId=7111.

[23] The data come from *China's National Climate Change Programme* (June 2007): 6, at http://en.ndrc.gov.cn/newsrelease/P020070604561191006823.pdf.

[24] For a discussion of the options open to consuming countries to counter OPEC's opportunistic moves, see Bohi and Toman, page 14.

[25] See for a simulation of the effects of a two year supply shock and the limits to the usefulness of strategic reserves, D.L. Green, D.W. Jones, and P.N. Leiby, "The Outlook for US Oil Dependence," *Energy Policy* Vol 26, No. 1 (1998): 55-69.

[26] See Amy Myers Jaffe and Ronald Soligo, "The Role of Inventories in Oil Market Stability," *The Quarterly Review of Economics and Finance* Vol. 42 (2002): 401-422.

[27] Daniel Yergin and Martin Hillenbrand, eds., *Global Insecurity* (Boston, MA: Houghton Mifflin, 1982).

[28] See Baker Institute Study, "The Role of Nuclear Power in Enhancing Japanese Energy Security," (October 2005) available at www.rice.edu/energy.

[29] Op. Cit., Baker 2005.

[30] Clifford Krause, "Oil-Rich Nations Use More Energy, Cutting Exports" *The New York Times* (9 December 2007).

[31] See case study on Indonesia in the Baker Institute study, "The Emerging Role of National Oil Companies on International Energy Markets," available at www.rice.edu/energy.

[32] Byrne: 4564. Texas, for example, has a 5% renewable energy portfolio standard, while California's is 20% by 2010.

CHAPTER V:
OVERCOMING THE ECONOMIC BARRIERS TO CLIMATE CHANGE AND ENERGY SECURITY

By Jason Furman, Jason E. Bordoff, Manasi Deshpande, and Pascal J. Noel

A Strategy for American Power:
Energy, Climate, and National Security

OVERCOMING THE ECONOMIC BARRIERS TO CLIMATE CHANGE AND ENERGY SECURITY

By Jason Furman, Jason E. Bordoff, Manasi Deshpande, and Pascal J. Noel

Introduction

The economic decisions of consumers and businesses, if left entirely to their own devices, would present an insurmountable barrier to addressing climate change and energy security. Although there is an increasing consumer taste for environment- and climate-friendly products, voluntary actions motivated by goodwill are not likely to come anywhere near what is required to slow climate change by any meaningful amount. Absent government policies directed toward overcoming the economic barrier, carbon emissions are expected to grow more than 75 percent by 2050; just preventing this rise would require a very different organization of the production and use of energy over the coming decades.

It is now almost universally accepted that global climate change is a reality. In the past century, the Earth's average annual surface temperature rose 0.7 degrees Celsius. There is little doubt that humans have contributed to this warming, particularly by burning fossil fuels such as coal and oil. The Intergovernmental Panel on Climate Change (IPCC 2007) asserts with "*very high confidence* [emphasis in original] that the globally averaged net effect of human activities since 1750 has been one of warming" (5). In fact, this year's Nobel Peace Prize was awarded to Al Gore and the IPCC for their efforts on the issue of climate change. The IPCC projects that, if emissions continue on their present course, global temperatures will rise another 4 degrees Celsius by 2100. This temperature change may trigger massive climatic shifts, including rising sea levels, more frequent and more severe storms, increased flooding and drought, and other dramatic changes in weather patterns. Economists estimate that the eventual damage is likely to be substantial For example, estimates indicate that a doubling of greenhouse gas (GHG) concentrations would reduce GDP by 1.0 to 1.5 percent in developed countries, and by 2.0 to 9.0 percent in developing countries, whose economies

depend heavily on agriculture (Cazorla and Toman 2000). Even these estimates, however, do not reflect the heavy human impact from increased incidence of water- and insect-borne diseases as well as the loss of lives, homes, and livelihoods from flooding or drought.

While climate change is a recently recognized problem, energy security has been a concern for the United States since the oil price shocks of the 1970s. Part of the energy security problem is economic: oil shocks have played a major role in nine of the ten U.S. recessions since World War II. Sharp increases in oil prices can disrupt firms' usual methods of production and reduce households' purchasing power, often triggering drops in consumer confidence and concomitant reductions in economic activity (Hamilton 1983, Hamilton and Herrera 2004). The higher oil prices can also feed into higher prices of other goods and thereby induce contractionary monetary policy (Bernanke, et al. 1997). Lower energy intensity, improved management of monetary policy, and greater flexibility of the economy have decreased, but not eliminated, the economy's vulnerability to oil shocks (CBO 2006a). This economic situation presents an enormous barrier to action, as policymakers are prone to managing such conditions rather than betting on major changes improving it.

Another part of the energy security problem concerns the global nature of the energy markets, and the geopolitics that exert heavy influence over such markets. Thomas L. Friedman, Pulitzer Prize–winning journalist and columnist for the *New York Times,* presents evidence that oil-wealthy states increasingly resist international norms and conventions as their oil wealth rises (Friedman 2006). U.S. foreign policy is limited by the threat that these oil-supported authoritarian governments could withhold oil from world markets and trigger shortages and price spikes; indeed, even if the United States is not a consumer of these nations' oil, the oil it does purchase is still subject to global pricing. Friedman also shows that higher oil prices cause worrisome domestic impacts in these "petrolist" countries, eroding "free speech, free press, free and fair elections, an independent judiciary, the rule of law, and independent political parties." Furthermore, oil dependence has contributed to a U.S. military presence and political involvement in the Middle East over the past 50 years, diverting U.S. resources and creating popular resentment against the United States that terrorist organizations have exploited as a recruiting tool, using oil wealth to fund their operations and squeeze the U.S. economy all at once.

The question now is not *whether* to do something about this challenging web of economic and market conditions that form a barrier to change, but rather *what* to do about them.

THE ECONOMIC BARRIERS

The core economic barrier to energy security—defined by CNAS as energy supplies that are geopolitically reliable, environmentally sustainable, and physically secure—is the very large gap between the cost of energy to individual consumers and producers and the cost to society as a whole, a gap that economists call an "externality." In the cases of coal and natural gas, this externality is entirely the result of the role that carbon plays in global climate change and it is borne by the entire world. In the case of gasoline and other petroleum products, the carbon externality is compounded by other costs, including the geopolitical effects of oil consumption and the costs of congestion and accidents.

A second economic barrier is the private sector's underinvestment in research and development (R&D), especially speculative, long-range research. The problem is that when companies generate new ideas, much of the benefit of these ideas is captured by other companies. This leads to underinvestment. This is not specific to the energy sector; it is characteristic of every aspect of the economy. But

it might be particularly severe in the energy sector, where much of the innovation itself is directed at generating social benefits that will not be captured, in large part, by any single company—compounding the externality associated with the innovation itself.

Finally, a third set of economic barriers center around the fact that consumers may not have all the information they need to make informed choices and, at least in some cases, principal-agent problems can lead to suboptimal investments in energy efficiency, for example by landlords.

HOW TO OVERCOME THE ECONOMIC BARRIERS

There are a number of ways to overcome these barriers. Overcoming them in the wrong way would be very harmful to the economy; however, overcoming them in the right way could generate enormous environmental and energy security dividends at a comparatively small economic cost. Economists across the political spectrum generally agree on how to deal with the problems of climate change and energy security, perhaps more so than on most other economic issues.

This paper draws on economic research to synthesize the economic consensus on climate change and energy security into a specific two-part strategy to overcome the economic barriers to establishing a sustainable climate and energy policy (an important third part of any viable strategy is to involve other nations in the process, an issue that goes beyond the scope of this paper). A summary of these two parts is:

PART 1. *Price carbon and oil correctly so that the private sector has an incentive to reduce their use.*

Carbon and other GHG emissions—as well as the oil use that constitutes much of their generation—can be reduced in myriad ways: by adopting more energy-efficient technologies, shifting to renewable energy or lower-carbon energy, capturing and storing carbon, or making behavioral changes like driving less. The government has limited knowledge of the most efficient ways to reduce emissions, especially since the cost of reductions varies enormously among the different methods and among firms and across families. Instead of mandating specific individual and firm-level actions, the government should pursue this more effective and less costly set of policies:

- The government should put a price on carbon emissions, either by auctioning off a limited number of tradable permits to emit carbon (a *cap-and-trade system*) or by implementing a tax on carbon emissions (a *carbon tax*).
- The government should also consider additional market measures to make the price of oil commensurate with its economic and national security costs, although pricing carbon would already increase the price of oil closer to its true social cost.
- Revenue generated by either a tax or a cap-and-trade system should be used to address the distributional problems associated with the higher energy prices they will generate.
- Once a price mechanism is put in place, the government should reevaluate many current regulatory or command-and-control policies that become at best superfluous, and at worst costly and inefficient.
- Once firms and individuals are faced with the social cost of their actions, they will naturally

find the best way to reduce their own emissions and oil consumption given the cost they face. Both methods of pricing carbon—cap-and-trade and a carbon tax—are economically similar. As a result, the critical questions for policymakers are, "Which is more politically feasible?" and "Which is more likely to be implemented in a sound manner?"

PART 2. *Increase and redirect public investments on basic research and on long-run speculative energy technologies.*

Technological breakthroughs are essential for breaking America's oil addiction and reducing the cost of meeting GHG emissions goals. Pricing carbon will stimulate a large increase in private sector research, but the public sector also has an important role to play. Several components of this role include:

- The federal government should reorganize efforts by creating an energy technology initiative for basic research into ideas with the potential for eventual commercial application. The goal is to sponsor basic research that the private sector is unlikely to undertake on its own while taking into account market demand and commercial viability.
- Federal efforts should also invest in highly speculative, high-risk, high-reward areas—the sort of blue-sky, long-term research for which no commercial application may be apparent.
- Federal efforts should be scaled up, but in a manner that is mindful of diminishing returns.
- The government should fund this increase by redirecting expenditures on counterproductive or superfluous energy subsidies. These reforms could generate up to $14 billion annually in new funding.
- Public policy should use prizes, tax reform, and patent reform to encourage private innovation.

PART 1 IN DETAIL: Price Carbon and Oil Correctly

The problem of climate change stems from emissions of carbon and other greenhouse gases. Similarly, energy security is threatened by excessive consumption of oil in the United States. Making firms and consumers face the social costs of carbon emissions and oil use is the single most important tool for mitigating climate change and promoting energy security. As a result, policymakers across the political spectrum—from Gary Becker, Alan Greenspan, and N. Gregory Mankiw to Al Gore, Paul Krugman, and Joseph Stiglitz – support a price mechanism for carbon emissions or gasoline, or both.

U.S. policymakers need to work toward two goals to overcome the economic barrier: reducing emissions and reducing oil consumption. This section discusses two price mechanisms, or ways to attach a price to carbon emissions or oil such that their climate and energy security costs are reflected in this price, that would move the nation toward achieving those two goals. The first mechanism is a carbon tax, in which the government would establish a direct price on carbon emissions and allow the market to determine the resulting quantity of emissions. The second mechanism is a cap-and-trade system, in which the government would establish a target quantity of emissions and issue tradable permits to firms in the amount of this target, allowing the market to determine the price of these permits.

Price mechanisms are better than command-and-control policies. This section discusses why that is the case, and how the two price mechanisms differ. Since well-designed versions of the two price mechanisms have similar effects, the most important considerations in deciding between them may be their probability of being designed properly and their political feasibility.

Table 1

SOURCE OF CARBON EMISSIONS FROM FUEL CONSUMPTION, 2005

	Coal	Oil	Natural Gas	Total
Residential	12%	2%	6%	20%
Commercial	12%	2%	5%	19%
Transportation	0%	32%	1%	33%
Industrial	12%	8%	8%	28%
Total	**36%**	**44%**	**20%**	**100%**

Source: Calculations based on Stavins (2007), includes indirect emissions from electricity use. Detail may not add to totals due to rounding.

The goal of reducing emissions. Climate change is caused by the buildup of CO_2 and other greenhouse gases in the atmosphere. The atmospheric concentration of CO_2 has risen from about 280 parts per million (ppm) in the pre-industrial era to 379 ppm in 2005 (IPCC 2007), and concentrations of CO_2 are projected to rise to anywhere from 600 ppm to 1,550 ppm by 2100, depending on the action taken to reduce emissions (IPCC 2007). Such an increase would induce climate changes far more severe than those the world has experienced to date. Scientists generally agree that atmospheric concentrations of CO_2 should be stabilized at 450 to 550 ppm to avoid serious climate consequences.

Climate change is a true global commons problem in that carbon emitted by one country contributes just as much to climate change as carbon emitted by another. The atmospheric impact of a ton of carbon is identical whether it is emitted by a driver or a power plant, whether it is emitted in the United States or China, and even—for the most part—whether it is emitted now or 20 years from now.[1] Table 1 shows U.S. CO_2 emissions from fuel consumption by source and sector in 2005.

The goal of reducing oil consumption. Energy security entails a similar challenge, although in this case the goal is to reduce the consumption of oil in the United States. Spending less on oil as a share of total output would reduce the

macroeconomic costs from oil price volatility (Hamilton 2005). If oil played a smaller role in the economy, a sudden or gradual price increase would have a smaller effect on economic activity and the overall price level. Given that the United States accounts for one quarter of world oil demand, reducing U.S. oil consumption would decrease revenues for authoritarian oil-exporting regimes, curbing their international influence and repressive domestic tendencies (Friedman 2006; EIA 2007c). Reducing revenues for many of the largest oil exporters could also reduce funds flowing to terrorist organizations, though to be sure only a tiny fraction of oil revenues have been siphoned to finance terrorism. Finally, significantly reduced oil consumption could alleviate the need for some of the U.S. military presence overseas, decreasing resentment among the public in these countries and preserving valuable American resources (Delucchi and Murphy 2006).

There is debate about whether the goal should be (a) reducing oil *consumption* by reducing domestic demand, or (b) reducing oil *imports* by either reducing domestic demand or increasing domestic supply.

It is true that reducing oil imports through raising domestic supply has benefits, including the potential to lower world prices and to reduce transfers to oil-exporting nations. However, reducing U.S. demand for oil has two major benefits over raising domestic supply. First, lowering energy demand would have significant climate benefits, while increasing the domestic oil supply would exacerbate the climate problem by lowering prices and encouraging consumption. Based on the CNAS definition of energy security, the energy problem cannot be truly solved if the solutions are environmentally unsustainable. Second, a reduction in the demand for oil would enhance energy security more than a comparable increase in supply. Because oil can be shipped at low cost relative to its value, the price of oil is essentially determined by the world market regardless of where it is produced. While reducing imports may decrease payments to oil-exporting nations, it will not decrease U.S. vulnerability to oil price shocks since turbulence in any oil-producing nation—even those from which the United States does not import oil—affects the global price of oil, whether it comes from the United States or Saudi Arabia or Mexico. As long as oil continues to play a dominant role in the U.S. economy, oil price shocks will raise risks of both recession and inflation, even if the United States reduces imports substantially. Since reducing imports cannot shield the U.S. economy from shocks, such a policy would not free U.S. foreign policy, reduce its strategic interest in stabilizing Middle East oil supplies, or prevent money from being spent securing that interest militarily. Indeed, it is telling that Iran continues to play its oil card in international negotiations even though the United States has not imported a drop of Iranian oil in 25 years (Sandalow 2007). Promoting energy security will therefore require a comprehensive plan to reduce domestic oil consumption.

Choosing the right policy mechanism. Given these goals, policymakers have a fundamental choice between two approaches to achieve reduced oil consumption and GHG emissions. In the first system, known as command-and-control, the government either sets source-specific emission and consumption limits or requires the adoption of particular technologies. The alternative to command-and-control is a market-based price mechanism (either a carbon tax or cap-and-trade system) in which the government puts in place incentives to reduce carbon emissions but leaves specific decisions to individual firms and consumers. It is also possible to combine market mechanisms with command-and-control policies. The next section details the advantages of a market-based approach, primarily as it relates to the goal of mitigating climate change. The arguments

in favor of market mechanisms are identical in the case of reducing oil consumption.

COMMAND-AND-CONTROL VERSUS PRICE MECHANISMS

Command-and-control systems to reduce emissions or to curb oil consumption come in a variety of forms. The canonical form is a specific mandate, like the prohibition of chlorofluorocarbons or a minimum requirement for energy efficiency for appliances. Other examples from recent energy and environmental policy include Corporate Average Fuel Economy (CAFE) standards, which require new cars to achieve a certain average fuel economy; renewable portfolio standards, which specify the percentage of electricity generation that must come from renewables; and gasoline blend requirements, which mandate the percentage of fuel that must come from renewable sources like ethanol.

Another form of command-and-control is the government trying to pick "winners and losers" —specific technologies it believes will be effective or ineffective. For example, it can pick winners by offering subsidies for specific technologies like hybrid cars and corn-based ethanol, or by funding specific demonstration projects like it did with the Synthetic Fuels Corporation in the 1980s.

Command-and-control policies have achieved some successes. For example, corporate average fuel economy standards have reduced gasoline consumption, improving U.S. energy security and helping to reduce carbon emissions. The key question going forward, however, is not whether these programs are effective, but rather whether they are the most effective way to achieve certain goals, and in particular whether there are more economically efficient approaches that are also politically feasible. This question is especially important as the United States becomes substantially more ambitious about the magnitude of its emissions reductions and other goals.

Command-and-control policies have important drawbacks compared to price mechanisms, which use market forces to reduce consumption of carbon and oil by attaching an extra price to these goods. First, the government has limited knowledge of the best ways to reduce GHG emissions or oil consumption. Choosing the best way among myriad options would require a sophisticated understanding not only of technology and economics, but also of individual preferences. The government would have to know, for example, which factories could reduce their energy use at the lowest cost and which people would be most willing to switch to public transportation.

The government's information limitations are compounded by two factors. The first is that some efficiency standards are likely to be the result of political pressure from special interests rather than objective cost-benefit analysis. The less knowledge the government has, the more powerful these political factors will be. Moreover, the economy evolves rapidly while regulations tend to persist and to be slow to change. Second, command-and-control systems generally cover only a fraction of the economic and behavioral choices that affect emissions or oil consumption. For example, renewable portfolio standards affect only one dimension of choice in the production of one source of emissions—electricity generation—and therefore do not necessarily take advantage of the cheapest way to reduce emissions, even within the electricity sector. Similarly, CAFE only affects car purchases but does not address choices like how much to drive or whether to carpool. Other command-and-control policies, such as efficiency standards for appliances and homes, leave untouched a large fraction of the decisions that could result in GHG emissions.

This limited scope of command-and-control systems can result in unintended side effects that undo some of the benefits of the regulation or raise the cost of the regulation. In particular, leaving

some types of activities uncovered will encourage those activities relative to the regulated activities. CAFE standards, for example, require the purchase of more efficient automobiles, but because those automobiles are cheaper to operate per mile, these standards may actually encourage more driving (Parry, et al. 2007; Fisher, et al. forthcoming). Moreover, since most efficiency standards apply only to new purchases, and since they raise the price of these new purchases, they create an incentive for people to use their old, inefficient cars and appliances for longer. Imperfectly set standards can also create counterproductive incentives for consumer choice; for example, they can push consumers from automobiles, which are covered by CAFE standards, to SUVs, which are covered by looser standards and have poor fuel economy.

Finally and least appreciated, command-and-control systems can have adverse distributional consequences that are both hidden and difficult to remedy. A standard that mandates a minimum level of energy efficiency for appliances, for example, will tend to raise the price of appliances. Facing higher costs from the standards, manufacturers are likely to pass these costs down to consumers in the form of higher prices. These price increases will have a bigger percentage impact on the purchasing power of a low-income family than it does on a high-income family. But in contrast to, say, a carbon or oil tax, these impacts are hidden and have barely been studied by researchers. Moreover, even if the impacts were understood, it would be difficult to remedy them because standards do not raise a pool of federal money that can be used to help alleviate the disproportionate impact of higher energy prices on families.

Incentives for particular technologies like hybrid cars or corn-based ethanol are similar to command-and-control regulations. In an economy without a price on carbon or oil, these incentives can be a very effective way to improve efficiency, reduce emissions, and promote energy security. For example, subsidizing cars that use less gasoline can accomplish many of the same goals as taxing cars that use more gasoline. But these policies also suffer from the same information limitations as command-and-control policies. Moreover, they amount to about $14 billion annually—costing each household more than $110, the equivalent of a 10 percent increase in the household's electricity bill.

Finally, the government can attempt to pick the next set of technological winners and make investments in them. To date, this process has been remarkably unsuccessful. Peter Ogden, John Podesta, and John Deutch (2007) note the lack of success of many Department of Energy (DOE) demonstration projects since the 1970s, citing as examples the Clinch River Breeder Reactor from the early 1970s, large-scale synthetic fuel projects, and the Central Solar Power Tower in California.

Many command-and-control policies aimed at reducing GHG emissions and increasing energy security have accomplished some of their goals, but often with costly side effects and economic inefficiencies. These side effects would only grow larger if the policies were scaled up to accomplish the magnitude of emissions reductions contemplated under most current climate change policies. Fortunately, almost all of these problems can be remedied by an alternative set of policies that rely on market mechanisms.

A more cost-effective way to reduce carbon emissions and oil consumption, and to therefore overcome the economic barrier to energy security, is to utilize the power of the market. Voluntary exchange in competitive markets generally makes everyone better off—the purchaser will only buy a product if he or she values it at more than the sales price, the seller will only sell it if it costs less than the sales price to produce, and everyone not a party to the transaction is indifferent. This presumption

breaks down when the product in question produces harms that are not captured by the buyer or the seller—what economists call an *externality*. The best solution is not a command-and-control approach in which the government decides exactly how this socially costly action should be reduced. A better solution is a market mechanism which would attach a price to the socially costly behavior and then let producers and consumers make their own decisions on the best way to reduce that behavior given its cost.

In the context of the two stated energy security goals, reducing carbon emissions and oil, there are two ways to generate this price signal: a carbon tax and a cap-and-trade system. We consider the case of carbon emissions here, though the description is analogous for oil consumption. The classic solution is a Pigouvian tax, named after the economist who first proposed it, in which the producer or consumer would pay a tax equal to the social damage of emitting carbon.

Alternatively, the same outcome could be achieved using a cap-and-trade system. Unlike a tax, which would set a price target for carbon and allow the market to determine the resulting quantity of carbon emissions, a cap-and-trade system would set a quantity target and allow the market to determine the price of carbon. In this case, the government would issue a limited number of permits for the right to emit carbon, and then allow producers and consumers to trade those permits among themselves. The price of these permits would be determined by the market based on their scarcity. Firms that wanted to emit carbon would have to purchase permits at this price, in much the same manner that they would have to pay the government a tax to emit carbon under a carbon tax system.

A key question in designing a cap-and-trade system is how the permits are allocated. The limited number of permits issued by the government are a scarce resource that could have a total market value of $100 billion or more annually. At one extreme, these permits could be given away for free to industries that emit substantial quantities of carbon and other GHGs, a process sometimes called "grandfathering." This allocation method was used in the Acid Rain Program, a cap-and-trade system in the United States to reduce sulfur dioxide emissions, and in the European Union Emissions Trading Scheme, a cap-and-trade system in Europe to reduce carbon emissions. At the other extreme, the permits could be auctioned to the highest bidders and the revenue generated used for tax cuts, public investments or deficit reduction. Alternatively, policymakers could undertake a mixture of free allocation and auctioning. Most economists think the bulk of the cost of permits is passed through to consumers. Therefore, they generally are opposed to allocating more than 15 percent of permits for free because they consider such free allocations a transfer payment worth tens of billions of dollars or more to the favored industries. Most economists argue instead that 85 to 100 percent of permits should be auctioned off with the proceeds used to help protect families from the higher cost of energy or to pay for tax cuts, public investments, or deficit reduction that will strengthen the overall economy.

The major advantages of price mechanisms over command-and-control regulations are innovation, flexibility, and cost effectiveness. Under either a carbon tax or cap-and-trade system, firms would search for methods to reduce emissions in order to avoid paying the tax or using permits. There are numerous ways a firm could reduce emissions, from changing its production process to shifting the sources of its energy or raw materials. Firms that figured out the most cost-effective ways to accomplish this would succeed, and, in a competitive economy, other firms would either have to copy their best practices or cease to exist. Given the proper incentives, the decentralized decisions

of profit-maximizing firms would lead to substantial innovation and ingenuity in curbing carbon or oil use—well beyond anything that regulators could envision.

Firms would pass on most of their increased costs to consumers, who would respond to these higher prices by adjusting their behavior.[2] For example, if gasoline prices were to rise, consumers would respond by buying more fuel-efficient cars, switching to public transportation, carpooling, or driving less. The mixture of these solutions would vary from person to person, based on each individual's tastes and personal circumstances. As with firms, the flexibility of price mechanisms would allow consumers to make the most cost-effective choices in response to these price signals.

Comprehensive market mechanisms are well suited to the nature of the climate and energy security challenges. As noted earlier, the reduction of either a ton of carbon from automobiles or a ton of carbon from electricity generation would have the same effect on mitigating climate change. Similarly, it does not matter which cars use less oil, as long as total consumption falls. The key to addressing climate change and energy security is to generate emissions and consumption reductions wherever they are cheapest; a market-based option that prices carbon emissions provides precisely the incentive to undertake the most cost-effective carbon reductions.

IMPACT AND COST OF PRICE MECHANISMS

Both types of market mechanisms have been proposed for tackling the climate and energy problems. For example, Gilbert Metcalf (2007) and Robert Stavins (2007) developed proposals for a carbon tax and cap-and-trade system, respectively.

A carbon tax would result in a price on the carbon content of oil. Additional measures should be considered to reflect energy security costs and other costs associated with oil. For example, Greg Mankiw, Harvard economist and former chair of President Bush's Council of Economic Advisors, has proposed phasing in a $1 per gallon gasoline tax over a decade.[3] Martin Feldstein of Harvard recently proposed a system of tradable gasoline rights as a way of reducing oil consumption to increase economic and national security.[4] Others have proposed further measures to price gasoline in a way that reflects separate externalities correlated with its use, most notably congestion and accident costs.

The following analysis evaluates the macroeconomic costs and price impacts of market mechanisms for controlling GHG emissions, but the same logic would apply to a system that was intended to discourage oil use and increase energy security. The imperative for designing such mechanisms in a distributionally equitable way would also apply to an oil-pricing mechanism.

Macroeconomic costs. Various analyses indicate that market mechanisms can achieve desired emissions reductions at acceptable aggregate costs. Stavins (2007) models two scenarios in which emissions in 2050 are cut by either 38 percent or by 75 percent relative to the baseline. He finds that they would cost 0.2 percent of GDP and 0.5 percent of GDP, respectively, in 2050.[5] Similarly, a recent report by the Congressional Budget Office estimates that a cap-and-trade system with a 15 percent target reduction in carbon emissions in 2010 would cut GDP by 0.28 percent if allowances were given away for free and just 0.13 percent if they were auctioned with proceeds used to reduce distortionary taxes (CBO 2007). These small costs must be compared to the gains from mitigating global climate change, including gains that come about when major developing countries reduce their own emissions in response to action by the United States.

Note that both a carbon tax and a cap-and-trade system would be more economically efficient if they were integrated into a global system. By expanding opportunities for low-cost emissions reductions, such integration could minimize macroeconomic costs in the United States of reducing emissions. In the absence of integration, there is a risk of "carbon leakage," whereby carbon-intensive industries could relocate to countries that do not have climate policies in place.

Consumer price impacts. A price mechanism would also have an effect on consumer prices. Metcalf (2007) estimates the impact on prices of consumer goods from a tax of $15 per ton of CO_2.[6] He finds that the price increases would be greatest for electricity, natural gas, and gasoline (see Table 2). Economic theory and evidence predict that if the price of a good rises, people will use less of it. After the oil price shocks in the 1970s, for example, consumers and companies took a number of steps to encourage efficiency, and gasoline consumption actually fell from 1973 to 1985 (EIA 2007c) despite a 50 percent inflation-adjusted increase in total consumer expenditures (BEA 2007). Conversely, when oil prices were relatively low from the mid-1980s through the late 1990s, cars got heavier and less fuel-efficient (EPA 2007b).

Table 2

CONSUMER PRICE IMPACTS OF A CARBON TAX

Commodity	Price Increase (%)
Electricity and Natural Gas	14.1
Home Heating	10.9
Gasoline	8.8
Air Travel	2.2
Other Commodities	0.3 to 1.0

Source: Metcalf (2007). A 2003 tax of $15 per metric ton of CO_2 (year 2005 dollars) is assumed to be passed fully forward to consumers.

Indeed, Metcalf predicts that his carbon tax would discourage the consumption of carbon-intensive products, which would in turn cause a 14 percent reduction in greenhouse gas emissions. Over time, a higher carbon tax rate would lead to increased technological change and a greater reduction in emissions. The results would be similar for an analogous cap-and-trade system.

Equivalence under certainty. In the hypothetical case of complete certainty, a carbon tax and cap-and-trade system would result in nearly identical aggregate costs, consumer price impacts, and reductions in carbon emissions.[7] For example, suppose the government were to issue tradable permits for carbon emissions that settled at a market value of $15 for a permit to emit a ton of CO_2. In this case, just as with a $15 per ton CO2 tax, any firm that could reduce CO_2 emissions for less than $15 per ton would do so, while any firm that would have to pay more than that would purchase a permit instead.

This economic equivalence under complete certainty of a carbon tax and a cap-and-trade system is most clearly illustrated in the respective proposals by Metcalf (2007) and Stavins (2007). Both propose applying the price mechanism "upstream"—at the producer rather than the consumer level. Coal mining firms would pay a tax or

use permits for the coal they extracted at the mine, while natural gas firms would pay at the wellhead or upon import. For the natural gas producer, the market price of the permits at, say, $15 per ton of CO_2, would be exactly equivalent to paying a $15 tax per ton of CO_2. It makes no difference to the natural gas producer whether it pays $15 to the government in taxes or $15 to a private trader for a permit.[8] As a result, both price mechanisms would have identical impacts on the behavior of fossil fuel producers and the price of fossil fuel, and thus on the decisions of those who use fossil fuels.

Achieving Distributional Equity with Price Mechanisms. As mentioned above, the direct effect of a carbon tax or a cap-and-trade system on the distribution of income would be similar. An upstream carbon tax applied to producers of coal and natural gas and oil refiners would likely be passed on to consumers in the form of higher prices for these commodities. As a result, the price of energy—and any product that uses energy for its production or transportation—will go up. Similarly, the cost to firms of using permits would be embodied in the price of final goods. In either case, the new equilibrium would have higher energy prices and lower energy consumption.

Metcalf (2007) estimates that a carbon price would represent a much higher fraction of income for a low-income family than for a high-income family. A $15 per ton CO_2 tax would reduce disposable income for the lowest-income households by 3.4 percent and for the highest-income households by only 0.8 percent. Metcalf proposes remedying this problem with an income tax credit against the first $560 in payroll taxes. This progressive tax cut would offset the regressive carbon tax and maintain broad distributional neutrality: while families would pay more for electricity and gasoline, these higher energy prices would be offset by lower taxes.

Even with this solution, however, the carbon tax would still make some groups better off and other groups worse off. Families with no workers, for example, would not receive the income tax credit. The tax swap would thus disproportionately affect people with disabilities, retired workers, and unemployed individuals. Although higher energy prices would result in automatic CPI adjustments to public benefits, additional steps would be needed to protect vulnerable families from increasing costs. Metcalf (2007) analyzes variants on his income tax swap proposal that include expanded Social Security benefits and lump sum transfers. He demonstrates that the latter two alternatives would do an even better job of achieving distributional neutrality than the tax swap. The Center on Budget and Policy Priorities has also begun extensive work on finding ways to protect the most vulnerable families from the price effects of climate change policies. They estimate that 14 percent of the revenues generated by a price mechanism would be needed to protect the most vulnerable low-income families, with much of the remainder needed to protect middle class families (Greenstein, et al. 2007). Other consumers, such as those who drive more than average, would also be made worse off by a carbon tax.

A cap-and-trade system could have a similar process of compensation, provided that the majority of the permits were auctioned rather than given away for free. Stavins (2007) estimates that if all the permits were auctioned off, his proposal would raise $120 billion to $270 billion in 2015—enough to compensate families for higher energy costs. Stavins proposes allocating 15 percent of the permits for free to affected industries (in practice implemented as a 50 percent initial auction, with phasing in of a complete auction over 25 years). This 15 percent of free allocation is consistent with some estimates of the cost to industry from the proposal (Goulder 2004; CBO 2007), with the remainder of the cost borne by consumers. If more than 15 percent of permits were given away for free—or if a substantial portion of the

auction revenue was used for purposes other than progressive tax cuts, benefit payments, or deficit reduction—then many families would be significantly worse off under a cap-and-trade system.

In addition to particular groups of consumers, certain industries and regions would feel the effect of the tax more acutely than others. A climate policy would create new jobs in new industries, but it would also destroy some jobs in older industries. Over the long run, the economy would adjust, but in the short run this transition could be disruptive to particular industries, such as coal mining, and particular geographic areas that are heavily dependent on these industries. Using a portion of the revenue generated by market mechanisms to compensate these areas and help them adjust to new, potentially higher-wage jobs in new sectors should be a critical component of any climate policy that aims to promote broad-based growth.

CARBON TAX VS. CAP-AND-TRADE

The discussion above stresses that carbon taxes and cap-and-trade are essentially identical under complete certainty. However, this equivalence unravels under the reality of considerable uncertainty about the costs of climate change and policies to mitigate climate change. The price mechanisms also have important differences in political economy and implementation. This section highlights only the most important differences; Metcalf (2007) and Stavins (2007) have a much more extensive discussion. Getting the design details correct from the start is critical because any system, once put in place, is likely to persist for decades and will be difficult to change (Repetto 2007).

Optimal design under uncertainty. In a certain world, a carbon tax and cap-and-trade system would achieve the same emissions reductions at the same cost. If the government knew the exact response of consumer and producer behavior to price changes, it could pick a carbon tax to achieve a desired level of emissions reductions. Similarly, if it knew the optimal price of carbon, it could design a cap-and-trade system to stabilize permit prices at that target. In the real world, however, there is substantial uncertainty. This is especially true of climate change, for which there is pervasive uncertainty about the degree of the problem and the effect of mitigation policies on the problem. Neither scientists nor government fully understand the potential damages of climate change or the exact cost of various abatement approaches.

In a classic analysis, Weitzman (1974) shows that taxes are the optimal response under certainty about cost per ton, while tradable permits are the optimal response under certainty about quantity targets. In the case of climate change, the marginal benefit of emissions reduction is relatively similar across the feasible range of reductions, which suggests, according to Weitzman's analysis, that the optimal instrument under uncertainty is a tax.[9] Pizer (1997) applies this economic framework to GHG reductions and finds that the optimal tax policy generates gains that are five times higher than the optimal cap-and-trade policy. This is largely the result of permit price volatility in a cap-and-trade system, which could create market uncertainty and thus dampen investment.

In theory, as originally shown by Roberts and Spence (1976), the optimal policy is a hybrid between a carbon tax and a cap-and-trade system. In this hybrid system, the government would issue a limited number of permits and establish a maximum price for these permits. Once permits reached this maximum price, sometimes called a "safety valve" or an "alternative compliance fee" (Stavins 2007), the government would begin issuing more permits at this price to minimize price volatility. In the case of climate change, such a hybrid system would likely look more like a carbon tax—with the price frequently hitting the safety valve—than a cap-and-trade system.

It should be noted that the Weitzman-Pizer analysis assumes that the policy is not being adjusted. In reality, it would probably be adjusted over time. If, for example, a carbon tax was not achieving large enough emissions reductions, it could be raised. Or, if a cap-and-trade system resulted in permits that were too costly, then more permits could be issued. Thus, the economic difference between the two systems, even in the face of uncertainty, may not be as large as this analysis suggests.

Political economy risks. Given the similarity in these effects, the more important differences between carbon tax and cap-and-trade may in practice be political economy and implementation challenges.

One important question is which system is more likely to be adopted in practice, a consideration that is especially important because it is more efficient to act sooner rather than later. Currently, a cap-and-trade system has substantially more proponents among elected officials of both parties, and it was the model recently adopted in the European Union to curb carbon emissions.

Another important question is whether the political incentives to ensure proper design are the same for both. This distinction here is clear: a cap-and-trade system creates more political economy risks for distributional effects, while a carbon tax creates more political economy risks for efficiency effects.

Under a carbon tax, the consequences for consumer prices and thus family incomes would be relatively transparent. This transparency would increase political pressure for a carbon tax that is combined with progressive tax cuts to protect families from this harm, like Metcalf's proposed carbon tax swap. Although the distributional impact of a cap-and-trade system is identical to that of a carbon tax, the former is substantially more opaque. The public may mistakenly view a cap-and-trade system as a way to reduce emissions without raising prices since the cost of emissions is hidden in valuable permits. People may also believe that a cap-and-trade system puts more of the burden on industry since firms, rather than consumers, are directly subject to the limits. Moreover, to the degree that the burden on consumers is less transparent, there would be less political pressure to use the value of this scarce resource to compensate families. The industries that appeared the most affected, or those with the most political power, would lobby for freely allocated permits, a process that is not only unfair to consumers, but also inefficient and unproductive. Discussing the potential for political manipulation, Mankiw (2007) argues that a cap-and-trade system in which permits are given away for free "is equivalent to a tax on carbon emissions with the tax revenue rebated to existing carbon emitters, such as energy companies." In other words, he says, "Cap-and-trade = Carbon tax + Corporate welfare." A well-designed cap-and-trade system, especially one that phased in a complete auction of permits, could address these distributional concerns.

On the other hand, the political economy of carbon taxes lends itself to economic efficiency concerns. First, powerful or politically sympathetic sectors of the economy may be able to obtain exemptions from carbon taxes. The result would be a patchwork system in which emissions reductions would be limited to certain sectors of the economy rather than being undertaken by the people or firms that could do it at the lowest cost. As a result, the system would share some of the economic inefficiencies of command-and-control.

Second, constant political pressure to lower the tax may compromise the credibility of a carbon tax, diminishing its effectiveness. If decision makers did not believe the instrument would be in place in the future—or if they believed that taxes would go down or number of permits up—then they would not make the proper investment decisions for cost-effective emissions reductions. McKibbin and

Wilcoxen (2002) show that this time-consistency risk can be avoided in a cap-and-trade system that allocates some long-term emissions permits to industry for free. Owners of these free permits would have little incentive to seek more future permits allocations because these allocations would depreciate the value of their permits.

Overall, a well-designed carbon tax and a well-designed cap-and-trade system would have similar economic effects. The two primary questions in deciding between them may therefore be "Which is more likely to be well-designed?" and "Which is more politically feasible?"

PRICE MECHANISMS PLUS COMMAND-AND-CONTROL?

Finally, we consider the question of whether price mechanisms should be combined with command-and-control mechanisms. The most crucial insight into answering this question is that, once a cap-and-trade system is in place, no additional regulations or measures will result in lower emissions or a better climate.[10] Forcing firms and consumers to reduce emissions in one area would simply diminish the incentive for them to reduce emissions in another, perhaps more efficient, area. For example, if an emissions cap is set at 6 or 7 billion metric tons of CO2, then no amount of CAFE standards, renewable portfolio standards, subsidies for hybrid cars, subsidies for ethanol, or investments in technology will result in emissions being lower or the climate being better, because total emissions would always be equal to the capped amount. As a result, any additional measures should be evaluated only by asking whether they lower the cost of achieving a given level of emissions reduction.[11] For this criterion to be fulfilled—and for energy security to be achieved in the ways that are best for the economy—the government must have the capability to do something with this command-and-control policy that the private sector cannot do itself.

In general, command-and-control policies do not meet this requirement, mostly because the government is at an informational disadvantage to the private sector. For example, with a price mechanism, electric utilities would consider the cost of carbon abatement in production decisions and determine the most efficient way to produce electricity while minimizing emissions. In contrast, a renewable portfolio standard that mandated a certain method of electricity production could not be less expensive than the most efficient system. Moreover, command-and-control policies could have other costs to consumers, in the form of higher taxes to pay for subsidies or higher costs to buy mandated consumer goods. For these reasons, the adoption of a price mechanism to reduce emissions or oil consumption should lead policymakers to be skeptical about approaches that made sense in the absence of a price mechanism.

There are, however, some specific cases in which the government may be able to help achieve a given emissions goal more cheaply. These possibilities include (1) helping individuals make more informed choices, (2) overcoming the problem of misaligned incentives between principals and agents, and (3) investing in research that the private sector would not have undertaken on its own. This subsection discusses the first two points, while Part 2 discusses the third point.

Policies that improve access to information on energy consumption may help firms and consumers find the most cost-effective abatement methods. Given information asymmetry in the electricity market, for example, requiring utilities to provide energy rate schedules, energy consumption calculators, or smart meters may increase consumer access to information and thus help consumers reduce emissions cost effectively. Similarly, improving and expanding the federal energy labeling programs would allow consumers to compare the energy efficiency of competing products.

However, improved access to information is unlikely to solve the principal-agent problem, even in the presence of carbon pricing. The principal-agent problem is one of misaligned incentives: in the construction sector, for example, home builders (the agents) have little incentive to promote energy efficiency because cost savings accrue largely to the building's tenants (the principals). The Lawrence Berkeley National Laboratory estimates that 35 percent of all residential energy is consumed by households affected by the principal-agent problem. In the immediate future, well-designed building codes and efficiency standards may be the only way to work around this market failure (Murtishaw and Sathaye 2006). In extreme cases such as these, command-and-control policies may serve an important role that price mechanisms cannot fulfill.

PART 2 IN DETAIL: Increase and Redirect Public Investments

New technologies will play a central role in diminishing the economic barrier to energy security in a cost-effective manner. Many observers believe that, given the abundance of cheap coal in the United States, any viable climate solution must include technologies to burn coal more cleanly and capture and store carbon released during coal combustion.[12] However, as a recent MIT study on coal explains, large amounts of private or public research, development, and demonstration will be necessary to determine the commercial viability, reliability, and safety of this "carbon capture" technology (MIT 2007). Technological progress is also essential for helping the United States transition to a post-petroleum economy, a step that most importantly involves developing alternatives to oil in the transportation sector, where fuel choice is currently virtually nonexistent. In addition to these well-defined objectives, investments in technology should focus on high-risk, high-reward research such as innovative ideas for removing CO2 from the atmosphere.

In general, the decentralized decisions of private individuals and firms should lead to economically efficient outcomes, *provided these actors have the proper incentives*. Ensuring that carbon and oil are priced correctly—either through cap-and-trade or taxes—is the most important incentive. These incentives would not just improve the utilization of existing energy sources and technologies—they would also serve as a major impetus for the private sector to invest in new technologies that improve energy efficiency, develop alternative fuels, or capture and store the carbon associated with fossil fuels. If a comprehensive price mechanism on oil and carbon were to be adopted, a large increase in private sector research into low-carbon and oil-efficient technologies would follow.

Even if carbon and oil were priced appropriately, however, the private sector would invest too little in research, for the reasons discussed below. As a result, society would have fewer options for addressing climate change and promoting energy security, making it more costly to achieve the reductions in GHG emissions and oil consumption envisioned under the price mechanisms discussed in Part 1 of this strategy. Conversely, climate research indicates that a combination of policies targeted at energy R&D and emissions pricing can reduce carbon emissions more cost effectively than emissions pricing alone, although the bulk of the reductions would still come from the price signal (see Fischer and Newell 2007; Goulder 2004; and CBO 2006b).

With the need for more research comes the need to refocus our existing research and technological investments on the basic research the private sector has less incentive to perform. In our current policy regime, where there is no price on carbon, it makes sense to adopt policies that subsidize certain technologies, such as hybrid cars. Although imperfect, these subsidies counteract the negative externality associated with the use of gasoline. Once carbon

and oil are priced correctly, however, such policies are unnecessary because individuals and firms will have an incentive to make the right choices about fuel efficiency. Therefore, if and when the United States adopts a price mechanism, it should also shift its technology policies to focus less on subsidizing particular technologies and picking winners and losers, and more on developing the basic research and long-run ideas that the private sector would not otherwise undertake. To fund this basic research efficiently, the government will also have to streamline its current funding process.

This transformation and refocus of energy R&D could be entirely paid for by redirecting existing subsidies that would be inefficient in an economy that priced carbon. Currently, the United States spends just $5 billion annually on energy research in areas like cellulosic ethanol, hydrogen storage, and carbon sequestration, while spending more than $14 billion annually on subsidies to energy-related activities, many of which are inefficient, environmentally harmful, or—in world with a price mechanism—unnecessary. Redirecting a portion of these subsidies to more basic long-run research would make it possible to double or even triple the existing energy R&D budget.

THE ECONOMIC ARGUMENT FOR FEDERAL SUPPORT FOR ENERGY RESEARCH

Even with a market-based price mechanism in place, there are several rationales for government investments in energy-related R&D. The most basic argument comes from the sizable economics literature showing that the social benefits of technological innovation often exceed the private benefits. That is because the benefits of innovation tend to spill over to other technology producers as well as to consumers—a phenomenon known as *knowledge spillover*. Several estimates show that innovators capture less than one quarter of the total value of their innovations.[12] As a result, the private sector will invest less in R&D than is necessary for the nation to realize the full potential of technological innovations. This is particularly true in the case of energy research. Studies show that federal energy R&D investments have yielded substantial economic benefits and led to significant knowledge creation (see National Research Council 2001). In a recent study of 29 DOE-sponsored R&D programs in energy efficiency and fossil energy, the National Research Council found that these programs, taken together, yield annual rates of return of more than 100 percent. Direct technology policy is needed to help capture these high social returns. As Stanford economist Lawrence Goulder (2004) explains:

> Technology incentives can deal with the market failure created by firms' inabilities to capture all the returns on their R&D investments. Direct emissions policies (such as carbon caps or carbon taxes) can deal with the market failure created by climate-related externalities. Attempting to address the climate change problem with only one of these policy approaches cannot fully correct both market failures.

In addition to knowledge spillovers, there are at least four other reasons for government investment in energy R&D that apply specifically to the climate and energy security challenges. First, the enormous uncertainties surrounding the future impacts of climate change limit and thus reduce the likely returns to R&D investment. Even if the price of carbon were set to account for more certain environmental externalities, there may be little incentive to invest in the types of high-cost technological solutions that would be needed in the case of catastrophic climate effects (Jaffe, et al. 2004). Absent government policy, for example, firms are unlikely to invest in costly research for highly uncertain—yet potentially enormously valuable—solutions to climate change, such as removing carbon from the atmosphere, seeding the ocean to absorb more carbon, or launching mirrors into space to deflect sunlight. With the private sector unlikely to invest in these uncertain and costly

endeavors, only government funding can facilitate their development into viable climate technologies.

A second, related problem is that the market value of climate innovations depends on the stability of long-term government policies. If government commitments to raise the price of carbon are not credible, and market actors believe the government may relax its emissions caps over time, the incentive to invest in expensive energy R&D in the short term will be severely curtailed. There are various reasons that the government might reduce the announced price of carbon in the future. Most obvious, perhaps, is potential political pressure to reduce taxes in response to rising energy prices or some other economic shock. But another reason is that a new technological breakthrough could dramatically reduce atmospheric concentrations of carbon, making future emissions less dangerous. The government may reduce the price of carbon to reflect the lower marginal damage of future emissions (CBO 2006b).

Third, as discussed in detail later in this paper, climate change is a global commons problem, in that carbon emitted in another country contributes just as much to climate change as carbon emitted in the United States. Successful domestic R&D efforts, whether funded by the private or public sector, could lower the costs of reducing carbon emissions in other countries as well as in the United States. Technology transfer to other nations could create large positive externalities that would justify government investment in energy R&D.

Finally, there is extra reason to support energy R&D given the energy security challenge and its economic barrier. Compared to carbon, pricing oil "correctly" may be more difficult, making it less likely that the government will send a strong enough price signal to induce innovations. Pricing carbon enjoys two advantages. First, despite the major uncertainties involved in measuring potential climate impacts, much work has been done to analyze the costs and benefits of each incremental carbon reduction. Second, the long-term nature of the climate issue means that policymakers can adjust the price of carbon as more information becomes available. Neither of these advantages exists with regard to the oil problem. Many energy security costs are geopolitical, not economic, and so are extremely difficult to measure in dollar terms. In addition, the energy security problem is immediate. The United States cannot afford to delay the pricing of oil until researchers determine the optimal price and consumption level. This difficulty in justifying and implementing the right market mechanism for oil makes a strong argument for federal support of energy R&D. Several technologies at various levels of development could completely transform the way the United States uses oil, especially in the transportation sector, which accounts for 70 percent of oil consumption (EIA 2007c). Here, government support for energy research could take center stage in moving toward a post-petroleum economy.

CURRENT FUNDING FOR RESEARCH

In recent decades, both public and private energy R&D have declined, despite an increase in the magnitude and urgency of the energy and environmental challenges. Although Department of Energy R&D expenditures have risen slightly in recent years, they have only returned to the funding levels of the early 1990s, which is still less than one third the DOE energy R&D spending in the late 1970s. As a share of GDP, federal energy R&D declined from 0.15 percent in 1978 to 0.02 percent in 2004.

At the same time, private energy R&D investment declined from 0.13 percent of GDP in 1981 to 0.02 percent in 2003. However, the sharp increase in private sector venture funding for the energy sector in the past few years indicates that this decline may be reversing itself. Hundreds of start-ups have formed in fields from biofuels to batteries. New

Energy Finance Ltd., a London-based research firm that specializes in alternative energy investments, recently released a report (2007) stating that private equity funds and venture capitalists invested $18.1 billion in the clean energy sector worldwide last year, a 67 percent increase over 2005 and much higher than government spending on energy R&D. That report estimates that worldwide private equity and venture capital investments in clean energy will grow at a compound annual rate of approximately 17 percent through 2013.

A FEDERAL ENERGY R&D STRATEGY

Developing a federal R&D strategy is critical for energy security. Various competing proposals have been advanced, including one by Richard Newell in a forthcoming Hamilton paper and another by Peter Ogden, John Podesta, and John Deutch (2007). Whatever specific details policymakers decide on, the focus should be to shift federal funding toward the kind of pure research that the private sector has little incentive to pursue. Commercialization projects should be left to the private sector, which has the willingness to invest in them and the motivation to choose wisely. To make the best use of federal resources, policymakers should consider the following elements of an effective R&D strategy:

First, the federal government should reorganize efforts by creating an energy technology initiative for basic research into ideas with the potential for eventual commercial application. To fund basic research in a targeted and efficient manner, the federal government will need to streamline its current energy R&D funding, a process that has proven difficult within the existing DOE organizational structure. A Council on Foreign Relations task force argues that the current federal R&D effort is too fragmented and unfocused (CFR 2001). Reorganizing and streamlining federal efforts would become even more important if the government scaled up funding.

Some experts have recommended a dedicated agency focused on innovative energy technology research modeled after the successful Defense Advanced Research Projects Agency (DARPA)—to be called ARPA-E. As described by the National Academy of Sciences, ARPA-E would "sponsor creative, out-of-the-box, transformational, generic energy research in those areas where industry by itself cannot or will not undertake such sponsorship," and "would be designed as a lean, effective, and agile—but largely independent—organization that can start and stop targeted programs based on performance and ultimate relevance" (Committee on Science, Engineering, and Public Policy [COSEPUP] 2007, 154).

However, DARPA may not be the best model for energy R&D. As Ogden, Podesta, and Deutch (2007) point out, DARPA focuses on performance rather than on the cost of technologies. In contrast, the goal of an energy technology initiative would be to develop technology in a manner that is mindful of its potential for widespread use. The authors note that an energy technology initiative would differ from previous large-scale government innovation initiatives such as the Manhattan Project and the Apollo Project. The goal of these military endeavors was to accomplish specific goals like creating a nuclear weapon or putting a man on the moon. With government as their single dependable consumer, these projects could proceed unfettered by considerations of cost or commercial viability. In contrast, the goal of public research in energy technology is to help the private sector develop a range of technologies that are consistent with market demand and commercial viability. Reorganized federal R&D efforts should thus include mechanisms to transfer the government's basic research into the hands of private companies that can make the decision to commercialize it.

Cellulosic ethanol technology is one example of an area with potential commercial application that would benefit from basic, long-term research.

Like corn-based ethanol, cellulosic ethanol is a substitute for gasoline. However, cellulosic ethanol would have significantly lower greenhouse gas emissions and displace far more gasoline than conventional ethanol, partly because the cellulosic process uses the entire plant while corn-based ethanol uses just the kernels and disposes of the rest. The private sector is close to developing first-generation conversion methods for cellulosic ethanol, but basic research into plant genetics and enzymatic processes would improve the efficiency and environmental benefits of this fuel.

In such areas of interest, government support should be concentrated where private firms are most likely to underinvest: in the basic research needed to develop the fundamental scientific ideas underlying these technologies.

Second, federal efforts should also invest in highly speculative areas. The type of R&D in which the private sector will most underinvest, and for which, concomitantly, there is the strongest need for government R&D spending, is exploratory research, the sort of blue sky, long-term research for which no commercial application may be apparent. One example is the prize idea set forth by Richard Branson and Al Gore for a technology that can remove one billion tons of carbon dioxide from the atmosphere annually. Since carbon dioxide removal is a public good, research into this area would probably fail to attract private sector investment despite its enormous potential. Another area of speculative research is geoengineering, the promising but somewhat controversial study of transforming the Earth's surface and atmosphere to slow climate change. Ideas include seeding the ocean to absorb more carbon and launching particles to improve cloud reflectivity. Despite the need for caution, these ideas, if proven effective, could have benefits that vastly outweigh the relatively small costs of the associated research. Like national defense or public infrastructure, these technologies would have to be provided by the government, making federal funding necessary to facilitate research into these high-risk but potentially high-reward public goods.

Third, federal efforts should be scaled up, but in a manner that is mindful of diminishing returns. Taken together, declining federal R&D funding and high social rates of return for R&D clearly indicate that more federal research funding is needed. But the government should be aware that increased federal energy R&D spending will see diminishing marginal returns, meaning that every additional dollar spent on research will yield less benefit and fewer results. Moreover, there are costs associated with increasing federal support for energy R&D too rapidly without building the institutional mechanisms and infrastructure to support that research.

The optimal trajectory of research is difficult to estimate. Richard Newell argues that no more than $7 billion annually could usefully be spent on federal energy R&D. The National Academy of Sciences proposes funding ARPA-E at $300 million for the initial year and rising to $1 billion after five years (COSEPUP 2007, p. 154). Nemet and Kammen (2007) argue that federal R&D spending of $10 billion to $15 billion a year over 10 years would be sufficient to stabilize emissions levels even in the absence of any market mechanism. Finally, even the *Stern Review,* which calls for drastic action to avert climate change, finds that the optimal level of global R&D spending is only about $20 billion a year (Stern 2007).

Fourth, the best way to fund increased federal research funding is not by searching for new sources of revenue, but by redirecting expenditures on counterproductive or superfluous energy subsidies. The federal government spends $14 billion annually—more than $110 per household—on subsidies for energy-related activities, which is more than double the current $5 billion

Table 3

FEDERAL EXPENDITURES RELATED TO CLIMATE CHANGE AND ENERGY	
	Expenditures (Millions in FY 2007)
Current Federal R&D Funding	
Climate Change Science Program	$ 1,822
Climate Change Technology Program	3,441
Examples	
Hydrogen Storage	35
Low Wind Speed Technology	12
Solid State Lighting	30
Cellulosic Biomass-Biochemical Platform R&D	33
Transportation Fuel Cells	8
Nuclear Hydrogen Initiative	19
Advanced Fuel Cycle/Advanced Burner Reactor	167
Sequestration	105
Integrated Gasification Combined Cycle (IGCC)	59
Subtotal	**5,263**
Policies that Hurt the Economy & the Environment	
Tax subsidies for oil, gas and coal production	1,840
Alternative fuel production credit [1]	2,370
Exclusion of reimbursed employee parking expenses	2,890
Unpaid royalties from oil and gas [2]	2,000
Subtotal	**9,100**
Other Subsidies For Energy-related Activities	
New Technology credit (PTC)	590
Tax credits for using energy efficient technologies	990
Ethanol & biodiesel subsidies	3,220
Other	170
Subtotal	**4,970**
TOTAL	**$ 19,333**

Source: OMB (2007a) and (2007b); Andrews (2006).

[1] Anecdotal evidence shows most of this credit goes to carbon-based fuels such as oil produced from shale and tar sands, but a small portion goes to renewable fuels such as gas from biomass. The tax expenditure on renewables best falls under the "unnecessary programs once carbon is priced" heading, but disaggregated data is not available.

[2] This number only counts the yearly revenues lost from omitting maximum price clauses in 1998 and 1999. It does not include revenue-loss estimates from underpricing or under collecting of royalties.

research budget. Certain reforms to repeal or redirect these subsidies could result in a doubling or even tripling of the current research budget.

These subsidy reforms fall into two categories. The first includes "win-win" policy reforms to repeal subsidies that both hurt the environment and distort economic choices. As shown in Table 3, the government could save $9 billion by pursuing win-win policies such as the following:

Cutting tax expenditures for coal, oil, and gas. Numerous government policies support the coal, oil, and gas industries through the tax code. While the average effective tax rate on corporate investment is 26.3 percent, the Congressional Budget Office estimates that the effective tax rate on investments in mining structures is 9.5 percent, and in petroleum and natural gas structures just 9.2 percent, the lowest of any industry (CBO 2005). In particular, there is little justification for three of the most costly fossil fuel tax expenditures: the expensing of exploration and development costs, percentage depletion, and the alternative fuel production credit. Cutting these expenditures would raise around $4.1 billion a year, reduce distorted investment choices, and cut carbon emissions.

Better managing royalties from oil and gas. Royalties paid by oil and gas companies are underpriced and often go uncollected. According to the Government Accountability Office, the federal government receives one of the lowest royalty payments of any government in the world (GAO 2007). Audit collections by the Department of the Interior are at an all-time low since it cut its auditing staff by 26 percent between 2001 and 2006 (POGO 2006). Meanwhile, a major clerical error by its staff in the late 1990s has already cost the government $1 billion and could cost around $2 billion a year for the next five years if it is not fixed.[13] Reforming the way the government prices and collects oil and gas royalties would raise revenue and lead to reduced carbon emissions.

Eliminating the subsidy for employer-provided parking. The federal tax exemption for employee parking expenses is currently greater than the exemption for mass transit expenses. Since driving emits almost three times more carbon than mass transit per passenger mile, the higher parking deduction may worsen climate change and exacerbate congestion, traffic accidents, and local pollution. Eliminating this tax subsidy for parking would mitigate these problems and recover $2.9 billion per year.

Ending subsidies for private planes. Small and private planes produce more than four times as many GHG emissions per passenger mile as large commercial airliners. Moreover, they contribute just as much, if not more, to the rising congestion delay at airports, which means more irritated passengers and lost productivity (Robyn 2001). To make these planes and jets pay fees commensurate with the costs they impose, airports should replace weight-based landing fees with congestion fees that vary by time of day (Brueckner 2004). Increasing charges for small and private aircraft would reduce airport congestion and GHG emissions by curbing demand.

In addition, a second set of subsidies for environmentally beneficial activities should be examined closely to see if they are still necessary in an economy that prices carbon and oil. Subsidies that should be reexamined once carbon and oil are priced, including tax credits for renewable energy, total $5 billion annually.

Table 3 shows the current allocation of the $19 billion annually spent on energy research and subsidies, much of which could be put to more efficient use by cutting counterproductive policies and programs and those that are unnecessary under carbon pricing. Reallocating this funding to more promising areas could eventually lower the cost of reducing GHG emissions and achieving energy security.

Finally, public policy should use prizes, tax reform, and patent reform to encourage private innovation. In addition to direct research funding, federal policy should also be geared toward encouraging the private sector to undertake more research focused on important social goals, such as reducing carbon emissions. The most important step in this regard, of course, is putting a credible and increasing price on carbon, a step that would unleash private sector ingenuity in developing cost-effective ways to reduce emissions. Several other steps, however, would also help.

In recent years, interest has grown in the use of prizes to spur technological innovation (NRC 2007). Prizes have several potential advantages over grants (Kalil 2006). First, they allow government to pursue a technological goal without deciding in advance which researchers or methodologies are best positioned to meet the goal. Second, prizes are awarded only in instances of success, eliminating the incentive to exaggerate the prospect of success. Finally, prizes can attract participation by small groups and individuals who would not otherwise do business with the federal government. Energy and climate change policies are particularly ripe for the use of prizes, especially after the Energy Policy Act of 2005 authorized the DOE to increase its use of prizes. Kalil proposes that the DOE use this mandate to encourage the development of renewable energy and energy-efficient innovations. An excellent example from the private sector is the $25 million prize established by Al Gore and Richard Branson for the development of a technology to extract at least one billion tons of carbon from the atmosphere annually.[14]

The current research and experimentation tax credit also plays an important role in encouraging research. Overall, econometric studies have found that the tax credit has been effective in the sense that private sector research spending has increased roughly one-for-one with each dollar of tax credit (Newell forthcoming; Hall and Van Reenen 2000). R&D tax credits also have the advantage of supporting R&D investment while leaving to the private sector specific decisions about which technologies are most promising. Deferring to the private market obviates the need for government to pick "winners" and "losers." The credit, however, is hampered by uncertainty about its future (it is typically extended for only one or two years) and other design features that could be addressed by making the credit permanent and reforming its delivery.

Finally, patent protection reform would help address the problem of knowledge spillovers and encourage private sector investment. By granting intellectual property protection, patents provide innovators with some assurance that they will be able to recoup their investments in new innovations. Indeed, the granting of intellectual property rights is the only policy instrument expressly ordained in the U.S. Constitution for the purpose of promoting innovation. Our current patent system, however, is overwhelmed and inefficient, increasingly awarding overbroad or unmerited patents. Numerous reform options have been proposed in response (e.g., Lichtman 2006) that calls for extending "presumption of validity"—a legal doctrine that obligates courts to enforce patents—only to those patents that undergo a more intensive review. Of course, while patents encourage innovation in the long run, they can raise the price of innovative technologies and reduce use of the technologies in the short run. The government should keep in mind these limitations when considering patent laws, especially since they could limit crucial transfers of low-carbon technology to the developing world.

Conclusion

Developing a comprehensive approach to overcoming the economic barrier for energy security and to address climate change and energy security will require thoughtful design, political will, and recognition of the differences between these goals. The energy security problem is immediate, while the potentially greater problem of climate change will unfold over the course of decades and centuries. The goal of climate policy should not be to reduce emissions immediately and dramatically, but rather to ensure a gradual reduction in emissions. Phasing in reductions would give society the incentive to develop new technologies and the time to adjust capital stock appropriately.

The central component of this strategy must be to develop price signals that reflect the full climate and energy security costs of burning fossil fuels. The government should price carbon and oil through a cap-and-trade system or a tax and then allow competition and innovation to take hold, while taking steps to protect those families least able to absorb these higher prices. But the government also has an essential role that goes beyond simply setting up the price framework: it must make the proper investments in research, development, and demonstration, recognizing that cost-effective and commercially viable technologies are necessary to solve the climate and energy security problems. The federal government should focus its funding on basic research, especially in areas where the private sector has little incentive to invest, while also rethinking how it manages and distributes those funds.

In developing its strategy, the United States must not lose sight of the global context of its domestic policies, especially those relating to climate change. Climate change is not the first global challenge to demand international cooperation—eradicating polio and reducing ozone depletion are relevant precedents—but it is unique in its disregard for national boundaries. Lack of resources or political will on the part of a few countries can dilute even the most concerted efforts by others to reduce greenhouse gas emissions. Strong commitment by the United States is likely to be the only impetus toward truly international cooperation. Any successful U.S. policy to address climate change and energy security must start with decisive action to deal with the economic barriers at home.

ENDNOTES

[1] Climate is affected by the total amount of CO2 and other GHGs in the atmosphere, called the concentration of GHGs, at any point in time. CO2 has an atmospheric lifetime of 50 to 200 years (EPA 2006). As a result, a ton of carbon emitted in 2007 or 2027 will add essentially the same amount to atmospheric concentrations and thus have a similar effect on temperatures.

[2] Economic theory predicts that this price pass through would happen regardless of how permits were allocated. For example, if a firm that emits carbon was given free permits it would still pass on the increase in the *marginal cost* of carbon emissions reductions to consumers, pocketing the value of the permits as a windfall profit.

[3] Greg Mankiw, "The Pigou Club Manifesto," *Wall Street Journal* (20 October 2006).

[4] Martin Feldstein, "Tradeable Gasoline Rights," *Wall Street Journal* (5 June 2006).

[5] Note that the welfare loss is 0.2 percent and 1.4 percent, respectively, which reflects the substitution of products and labor-leisure, as well as the reduction in output.

[6] A carbon tax can be levied in units of carbon or CO2. One can convert a tax rate denominated in units of CO2 to a rate in units of carbon by multiplying by 44/12. Thus a $15 per ton CO2 tax is equivalent to a tax rate of $55 per ton of carbon.

[7] There are some potentially important economic differences, including the different incentives the two systems would create for regulated utilities.

[8] The economic equivalence holds even if the natural gas producer is given the permits for free by the government, although the distributional impact would be different. In this case, for each ton of CO2 that is extracted, the natural gas producer loses one permit that it could have sold in the private market for $15.

[9] What matters for climate change is the *specific* concentration of carbon in the atmosphere, which is a function of emissions over the past 200 years. As a result, in any given year emissions contribute only a small portion of the future concentration of carbon in the atmosphere. This means that the first and last tons of carbon emitted in that year result in similar amounts of damage, and thus should have a similar price, a goal that is best achieved through a fixed tax rather than tradable permits.

[10] An obvious but not very realistic exception would be if the command-and-control measures were so stringent that, by themselves, they reduced emissions below the capped level. In this case, there would effectively be no market mechanism and thus all the problems discussed earlier would apply.

[11] An analogous argument holds for carbon taxes, although in this case the argument is that any given level of emissions reductions can be achieved by a specific carbon tax, while other regulations raise or lower the tax needed to achieve that reduction.

[12] One recent survey of the literature shows private investments in R&D have social rates of return between 30 and 50 percent, and private rates of return between 7 and 11 percent (Popp 2004).

[13] Edmund L. Andrews, "Report Says Oil Royalties Go Unpaid," *New York Times* online edition (7 December 2006).

[14] See "Branson Launches $25m Climate Bid," *BBC News* (9 February 2007).

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