Executive Summary

At least since the energy crisis of the early 1970s, the United States has wrestled with the difficult question of how best to ensure an adequate energy supply while protecting the environment. Today, this question continues to play a role in our political debates. Whether and how public policy might reduce reliance on imported oil, encourage lower-emission vehicles, or spur the development of new or cleaner sources of power are all regular matters of public discussion and concern.

It is in this context that the Manhattan Institute's Center for Energy and the Environment offers this publication. It is predicated on the belief that wise and prudent policies in these areas require a well-informed citizenry—one well versed in the facts. With that goal in mind, the Center sought, with the help of survey research conducted by Zogby Associates, to determine what Americans believe about energy and environmental issues. We report here on the answers given by 1,000 Americans, chosen to be representative of public opinion generally, on matters such as the sources of U.S. energy supply, the extent of the oil supply, the rate of global warming, and trends in atmospheric pollution. Our poll was taken at a time—the summer of 2006—when, because of a sharp increase in the price of gasoline, public interest in energy and environmental issues was particularly keen.

The survey found that the views that Americans hold about a wide range of these issues are, in key ways, inaccurate. Significant numbers of people appear to misunderstand such crucial matters as:

- The types of fuel that are the main sources of energy
- The main uses of energy supplies
- Which countries supply the U.S. with the most oil
- The extent of oil reserves
- The rate of global warming
- The terms of the Kyoto Protocol international environmental treaty
- The environmental record of nuclear power plants
- The extent of urban air pollution
- The effects of conservation and increases in energy efficiency

Herein we report on what might be called the "energy myths" to which many Americans subscribe—and their correctives. "Energy Myths, Energy Facts" is intended as a primer for educators, journalists, and public officials—for concerned citizens generally—as we seek twin goals: an energy supply sufficient to fuel continued economic growth; and environmental policies that will protect the public health and the quality of our lives.

About the Author

Max Schulz is a senior fellow at the Center for Energy Policy and the Environment at the Manhattan Institute for Policy Research. His work focuses on the practical application of free-market principles in energy debates at the international, federal, and state levels. The Center for Energy Policy examines the intersection of energy, the economy, and the environment, with particular focus on the national-security aspects of energy in the 21st century.

Prior to joining the Manhattan Institute, Mr. Schulz served as Senior Policy Advisor and Director of Speechwriting for United States secretaries of energy Samuel Bodman and Spencer Abraham. In four and a half years at the Department of Energy, he worked extensively on issues ranging from energy supply and demand to nuclear security and nonproliferation. In 2004, he was a member of the United States delegation to the International Atomic Energy Agency's 47th General Conference in Vienna.

Mr. Schulz is a graduate of Vanderbilt University. He lives in Washington with his wife and son.

Introduction

America faces crucial energy-policy decisions. Should we drill into petroleum reserves in Alaska to increase our domestic supply of oil? Should we reduce our reliance on oil, and, if so, how? Should we subsidize the development of alternative fuel sources, such as hydrogen and ethanol, or should we build more nuclear power plants? Should we invest in clean-coal technologies, wind farms, or solar power? Should we promote energy efficiency, or seek to reduce consumption? How should we react to global warming? Should we ratify the Kyoto Protocol? Above all, how do we balance our needs for energy and economic growth with the responsibility of stewardship over the earth?

Making these decisions wisely will require an informed public. Few other policy areas, excepting perhaps ballistic-missile defense, hinge so heavily on our knowledge of science and technology. Making sound energy and environmental decisions demands a citizenry that is not just guided by a general philosophy but informed about specific facts.

How well-informed are we about energy and the environment? To answer that question, the Manhattan Institute commissioned Zogby International to ask 1,000 Americans nineteen questions on issues ranging from Saudi oil to global warming, and then asked me to assess the accuracy of those beliefs. The survey was conducted in September 2006. Zogby International followed up in February of this year by querying another random sample of Americans on five of the original questions. The purpose of the follow-up was to see whether public opinion and understanding of certain issues had changed, particularly because of the high profile given to renewable energy research by the president in his 2007 State of the Union address and by newly empowered congressional Democrats.

In the main sections of this report, I argue that most of the beliefs revealed by the poll are not supported by the facts. In the concluding sections, I consider the policy implications of these misunderstandings and recommend some basic policy reorientations.

In preparing this report, I drew extensively on the work of two individuals. One, Peter Huber, is a colleague at the Manhattan Institute's Center for Energy and the Environment. Peter has produced two critically acclaimed books on these topics: *Hard Green* (1999) and *The Bottomless Well* (2005). The other source to whom I am indebted, Mark Mills, is a longtime friend of the Manhattan Institute. A physicist by training, Mark co-authored *The Bottomless Well* with Peter. Mark is a former staff consultant to the White House Science Office. The responsibility, however, for the text that follows is mine.

I invite the reader to gauge his or her own energy literacy by taking the following multiple-choice quiz, based on the MI/Zogby survey. The main text of this document considers and explains the answers in detail, proceeding question by question.

Max Schulz

Test Your Energy Literacy

1. Do you believe that most of America's energy comes from oil, or do you believe most of it comes from other sources?
   a. oil
   b. other sources

2. Which of these sources do you believe provides America with the most energy?
   a. oil
   b. natural gas
   c. coal
   d. nuclear
   e. wind and solar

3. Which of these sources do you believe provides America with the least energy?
   a. wind and solar
   b. coal
   c. natural gas
   d. nuclear
   e. oil

4. Which foreign country provides the U.S. with the most oil?
   a. Venezuela
   b. Canada
   c. Saudi Arabia
   d. Mexico
   e. Russia

5. What do you think is America's main use of energy?
   a. driving or traveling
   b. lighting
   c. heating or cooling
   d. other

6. How many people died in the Three Mile Island nuclear accident in 1979?
   a. none
   b. 3
   c. 27
   d. 117

7. Do you agree or disagree that America's cities are becoming more polluted?
   a. agree
   b. disagree

8. Do you agree or disagree that human activity, such as logging or development, is shrinking America's forests?
   a. agree
   b. disagree

9. True or false? The Kyoto Protocol on global climate change would require all countries to cut their greenhouse gas emissions.
   a. true
   b. false

10. Experts agree that some global warming has occurred during the last century. Just how much did the planet warm during that period?
    a. about 1° Fahrenheit
    b. about 2° Fahrenheit
    c. about 5° Fahrenheit
    d. about 7° Fahrenheit
    e. about 10° Fahrenheit

11. During which twentieth-century period did the earth warm the most?
    a. 1900 to 1950   b. 1951 to 2000

12. Ethanol has been suggested by President Bush and others as a replacement for gasoline. Compared with a gallon of gasoline, does the same amount of ethanol contain…?
    a. more energy   c. less energy
    b. the same amount of energy

13. Do you agree or disagree that America is addicted to oil?
    a. agree   b. disagree

14. Do you agree or disagree that the United States is overly dependent on foreign oil?
    a. agree   b. disagree

15. Do you agree or disagree that the world is in danger of running out of oil in this century?
    a. agree   b. disagree

16. Do you agree or disagree that the U.S. can meet its future energy demand through conservation and efficiency?
    a. agree   b. disagree

17. Which of the following sources of energy do you think is the safest to produce and use?
    a. oil   d. renewables
    b. natural gas   e. coal
    c. nuclear

18. Which of the following sources of energy do you believe causes the most damage to the environment?
    a. oil   d. renewables
    b. coal   e. coal
    c. nuclear   f. natural gas

19. Do you agree or disagree that energy exploration endangers wildlife in Alaska?
    a. agree   b. disagree

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I. ENERGY MYTHS

MYTH 1 MOST OF OUR ENERGY COMES FROM OIL

Much concern about energy rests on an assumption that our economy runs on oil. Media coverage of energy typically focuses on how crude-oil prices translate into prices at the pump. Political rhetoric mirrors this tendency to treat oil as the centerpiece of our energy economy. Perhaps it is not surprising, then, that 63.2 percent of survey respondents in September 2006 thought that oil provides most of America's energy. We asked the question again in February, shortly after the president decried America's dependence on foreign oil in his State of the Union address and the new Democratic Congress legislated efforts to punish "Big Oil." The share of respondents believing that most of our energy comes from oil had risen to nearly 68 percent.

SURVEY RESPONSES

Does Most of America's Energy Come from Oil, Or from Other Sources?

	Feb. 2007	*Sept. 2006
Oil	68	63
Other sources	26	31
Not sure	7	6

**Sept. 2006 survey nationwide of 1,000 adults, Sept. 12-14, 2006, MOE +/- 3.2 percentage points*

In reality, however, most of our energy does not come from oil. Sixty percent of U.S. primary energy consumption comes from other sources that largely generate electricity and heat, such as coal, natural gas, nuclear power, and renewable energies. Oil supplies the other 40 percent of energy consumed by Americans in a typical year—largely for powering cars, trucks, and planes—and, while important, is not as dominant in the American economy as many believe (see Table 1).

Oil usage can be disaggregated to better understand our energy economy. Fuels and technologies accomplish three major purposes: the generation of electricity (roughly 40 percent of our energy economy), raw heat (30 percent), and power for transportation (30 percent). In this three-pronged energy economy, coal, natural gas, and uranium (nuclear power) are the principal fuels for generating electricity. Natural gas and oil are the main fuels for generating raw heat, with gas providing the larger share. And oil is the main fuel for powering the transportation sector.

This snapshot reveals how energy use is evolving. For much of the twentieth century, oil generated both transportation and electricity. As late as the 1970s, many electric power plants were fired by oil. But today, just a small amount of Americans' electricity is supplied by oil. In another fairly recent development, natural gas has made large inroads in generating electricity.

Though oil and transportation account for just one portion of our overall energy use, they dominate debates and generate the most headlines. "Peak oil" theorists, including retired oil-industry geologist Colin Campbell, warn of impending calamities when the wells dry up.[1] Students of

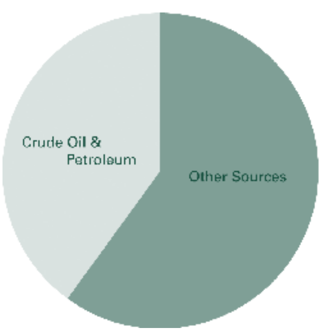


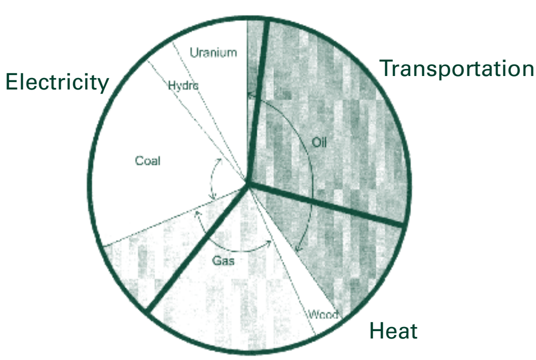
TABLE 1. U.S. Energy Consumption by Source, 2005

Crude Oil & Petroleum	40%
Other Sources	60%
Coal	23%
Natural Gas	23%
Nuclear	8%
Renewables	6%

Source: U.S. Energy Information Administration, Annual Energy Review 2005, diagram 1, "Energy Flow" global warming point with alarm to more than 200 million cars and trucks on our roads and to predicted increases in automobile ownership in emerging economies like China. For perhaps these reasons, President Bush challenged America to "move beyond the petroleum-based economy" in his 2006 State of the Union address.

> "Most of America's energy does not come from oil. Sixty percent of U.S. primary energy consumption comes from other sources that largely generate electricity, such as coal, natural gas, nuclear power, and renewable energies."

Yet we already are moving beyond the petroleum-based economy. The process has been under way for several decades, during which technological advances in microprocessing and computers have begun to change the energy-use landscape. In an era marked by computers, handheld PDAs, cellular phones, and iPods-—not to mention the Internet—Americans now use 82 percent more electricity than they did in 1980. This jump in electricity use accounts for over 85 percent of the growth in our energy demand during that time.[2] Sixty percent of America's gross domestic product now comes from industries and services that run on electricity., as opposed to just 20 percent in 1950.



Source: The Bottomless Well (Figure 1.6 on p. 11) by Peter W. Huber & Mark P. Mills.

FIGURE 1. Primary Fuel Uses

Electrification will likely intensify. In *The Bottomless Well*, Peter Huber and Mark Mills predict major electrical advances in the thermal sector of the economy.[3] Lasers, microwaves, magnetic fields, and other electric technologies will displace a significant portion of the heating now performed in conventional ovens and industrial processes. Computers and microprocessors will transform our vehicles, allowing electricity to power our cars and trucks instead of oil.

It won't all happen overnight; oil will continue to undergird our transportation sector well into the future. About two-thirds of the 7 billion barrels of oil that we presently use each year go into our gas tanks or become kerosene jet fuel (the rest is used for heating and for things like chemicals, plastics, and asphalt). Oil likely will remain our single biggest source of raw energy, a fact recognized by almost 40 percent of MI/Zogby survey respondents (see box). However, this does not refute the fact that most of our energy does not come from oil, nor will it in the coming decades.

> "If dependence on oil defined the twentieth century, reliance on electricity will likely define the twenty-first."

If dependence on oil defined the twentieth century, reliance on electricity will define the twenty-first. Where will it come from? Today, coal (49.7 percent), nuclear power (19.9 percent), and natural gas (18.7 percent) are responsible for the bulk of it. Hydropower provides 6.5 percent. Renewable energies such as solar, wind, and biomass provide about 3 percent—the same amount as oil's negligible contribution.[4]

The Energy Information Administration forecasts that total U.S. electricity consumption will increase by 43 percent by 2030. America's growing need for electricity would therefore be a wise focus for policymakers and media going forward.

MYTH 2 SAUDI ARABIA PROVIDES THE MOST OIL TO AMERICA

The largest percentage of respondents believes that we are overly reliant on Middle Eastern oil, particularly from Saudi Arabia.

SURVEY RESPONSES

Which Foreign Country Provides the Most Oil to America?

	Percent
Saudi Arabia	54.6
Not Sure	13.0
Venezuela	12.1
Canada	8.2
Mexico	7.2
Other/None	4.3
Russia	0.6

The reality, however, is far different. Though we are accustomed to believing that American energy security rests in the hands of Saudi sheikhs, in fact Canada is America's chief foreign supplier of crude oil and petroleum products, supplying the U.S. with more than 2.18 million barrels daily. Mexico is next on the list, providing more than 1.66 million barrels of oil daily. Saudi Arabia, with daily imports to the U.S. in the range of 1.5 million barrels, ranks third, followed by Venezuela, with nearly the same amount (see Table 2).

All told, less than 20 percent of U.S. petroleum imports come from the Persian Gulf, and just 11 percent of the total amount of petroleum Americans consume. Canada and Mexico, on the other hand, provide 28 percent of our imports and almost 19 percent of our total oil consumption. If the United States can be said to be beholden to any region for its oil supplies, it would not be the Middle East but the Western Hemisphere. Fully two-thirds of the crude oil and petroleum products that the United States uses come from the Americas.

TABLE 2. Top U.S. Petroleum Suppliers

In 2005, the United States consumed 20.8 million barrels of crude oil and petroleum products each day. Of that figure, more than 7 million barrels (34.1 percent) were produced domestically. The balance of 13.7 million barrels (or 65.9 percent of the petroleum that Americans use) was imported from more than 80 nations around the globe. The United States is by far its own top supplier, supplying more than three times as much as any other nation.

		2005 (bpd)	% of imports	% of total petrol con-sumed
1	Canada	2,181,000	15.9	10.5
2	Mexico	1,662,000	12.1	8.0
3	Saudi Arabia	1,537,000	11.2	7.4
4	Venezuela	1,529,000	11.1	7.4
5	Nigeria	1,166,000	8.5	5.6
6	Iraq	531,000	3.9	2.6
7	Algeria	478,000	3.5	2.3
8	Angola	473,000	3.4	2.3
9	Russia	410,000	3.0	2.0
10	United Kingdom	396,000	2.9	2.0
11	Virgin Islands	328,000	2.4	1.6
12	Ecuador	283,000	2.1	1.4
13	Kuwait	243,000	1.8	1.2
14	Norway	233,000	1.7	1.1
15	Colombia	196,000	1.4	1.0
Persian Gulf nations		2,334,000	17.0	11.2
OPEC nations		5,587,000	40.7	26.9
Non-OPEC nations		8,127,000	59.3	39.1
Western Hemisphere nations		6,779,000	49.4	32.6
Western Hemisphere incl U.S.		13,867,000	n/a	66.7

Source: U.S. Energy Information Administration

MYTH 3: AMERICA USES ENERGY MAINLY FOR DRIVING AND TRAVELING

In order to best formulate our energy policies, particularly when energy issues are tied up with questions of national security as well as environmental stewardship, it helps to have a firm understanding of just what we use energy for. As the survey results show, Americans lack this understanding.

Given the particular emphasis commonly placed on petroleum issues and the Middle East, it makes sense that just under half of the survey's respondents (48.7 percent) answered that driving and traveling constitute Americans' main use of energy.

SURVEY RESPONSES

What Is America's Main Use of Energy?

	Percent
Driving/traveling	48.7
Heating/cooling	33.7
Lighting	9.6
Not sure	4.3
Other/None	3.7

These answers suggest that when we think about energy issues, we do so in the context of our own experience. There is good reason for this: each of us is confronted daily with many ways to use energy, from the hot water in our showers, to the air conditioner in the living room, to the service station where we fill up our cars. We are less inclined to think of how energy is consumed more broadly throughout the economy.

According to the U.S. Energy Information Administration, our energy consumption breaks down in the following ways: industrial sector, 32 percent; transportation sector, 28 percent; residential sector, 22 percent; and commercial sector, 18.[5]

As is sometimes the case with government statistics, those numbers do a poor job of describing the manner in which we use energy. As mentioned on page 3, a better (and simpler) way to think of our energy consumption is in terms of a 40/30/30 energy economy. We do three basic things with the 100 or so quads of fuel that we use: generate electricity (roughly 40 percent); generate raw heat (30 percent); and move vehicles (30 percent). Viewed through this lens, it is clear that transportation is not America's main use of energy but just one of three major uses (and of those does not even constitute the largest share).

In the conventional sense—that is, when we think about where we use energy and what we use it for—there is no one thing that describes our "main" use of energy. In the unconventional sense, however, one can make the case that there actually is a single main use of energy that does not at first come to mind, namely, "wasting" it. The energy we use, whether in our gas tanks, our microwaves, or our air conditioners, can be used only after it is processed and refined into something usable. That necessarily entails waste. A power plant may lose half of the energy in a lump of coal in order to convert the other half into usable electricity. An automobile, which is really nothing more than a miniature power plant on wheels, is far less efficient in converting the energy in its gas tank into usable power.

When you hear government officials bemoaning how much energy we waste, remember that it takes energy to make energy. There is simply no way around this "waste." As Peter Huber and Mark Mills state in *The Bottomless Well*: "Some 80 to 95 percent of the energy we use never moves a useful payload like the driver in the car, never emerges from the glowing filament as a useful lumen of light, never leaves an antenna as useful electromagnetic waves, never heats food in an oven or cools it in a refrigerator, never makes it to the final point where it actually gets put to human ends.... It is only by throwing most of the energy away that we can put what's left to productive use." [6]

MYTH 4 WE ARE RUNNING OUT OF OIL

Common sense tells us that there is a fixed amount of oil in the earth and that each day we are getting closer to using it up. The same goes for other nonrenewable energy sources, such as coal and natural gas.

SURVEY RESPONSES

Is the World in Danger of Running Out of Oil in This Century?

	Percent
Yes	42.9
No	50.7
Not sure	6.4

Are we right to worry? Not anytime soon. Paradoxically, even as we have been pumping more oil out of the ground, we have seen estimates of the world's proven reserves (the amount of identified oil deposits that can be economically recovered using current technology) grow. In 1944, for instance, experts thought that the world had 51 billion barrels of crude oil left. Yet over the next six decades, we would pump more than 18 times that amount (917 billion barrels). Today, proven reserves have grown to more than 1.2 trillion barrels, a figure higher than the 1 trillion barrels that humanity has produced and consumed to date.

We have not "created" more oil. Rather, enterprising individuals have improved our technologies for detecting and extracting it. Twenty years ago, for instance, it was impossible to reach much of the oil under the deep waters of the North Sea. Now it costs less than $15 per barrel to extract it.

Taking into account new extraction technologies and discoveries of unconventional petroleum sources—which are not taken into account when calculating proven reserves—the world has at least a century's worth of recoverable oil resources. The British-based consultancy HIS Energy suggests that the planet's recoverable reserves might be as much as 2.4 trillion barrels. ExxonMobil has estimated global conventional oil resources at 3.2 trillion barrels.

Unconventional sources, such as oil shale deposits in the western United States and the oil sands in Canada and Venezuela, will yield even more recoverable resources. ExxonMobil's recent estimates suggest that there are 800,000 billion barrels of recoverable oil from these sources. Petro-Canada is more optimistic, estimating that Canada by itself has "more than 2.5 trillion barrels [in unconventional oil resources]. These deposits rival those of the Middle East and could satisfy today's global demand for the next 100 years."

These estimates may be conservative. As *Reason* magazine science correspondent Ronald Bailey notes, the U.S. Geological Survey "figures that the total world endowment of conventional oil resources is equivalent to about 5.9 trillion barrels of oil. *Proven* reserves of oil, gas, and natural gas liquids are equivalent to 2 trillion barrels of oil. The USGS calculates that humanity has already consumed about 1 trillion barrels of oil equivalent, which means 82 percent of the world's endowment of oil and gas resources remains to be used."[7]

It is important to note, too, that experts have repeatedly provided dire warnings about our running out of oil. The preeminent proponent of this school of thought was geologist Marion King Hubbert, who predicted in the 1950s that world oil production would peak around the year 2000. In other words, according to the "Hubbert's Peak" theory, we have passed the halfway point in terms of the world's recoverable oil production. A number of present-day oil-industry observers have taken up Hubbert's idea and believe that we are heading toward global economic catastrophe. If the world has used up about half its oil in about a century, goes the argument, what does that imply for the twenty-first century, given the increased demand for oil in China, India, and the developing world?

The good news about this bad news is that, historically, the doomsayers have been wrong. If the past is prologue to our future, technology and human ingenuity will likely prove today's doomsayers wrong as well (see box).

RUNNING OUT?

1874 – State geologist of Pennsylvania said that the U.S. had only enough oil to last four years.

1885 – U.S. Geological Survey said that California had "little or no chance of finding oil." California would go on to become one of the United States' largest domestic oil suppliers. The Golden State has produced more than 7.5 billion barrels of oil in the last quarter-century alone.[8]

1914 – The U.S. Bureau of Mines claimed that the country had only a ten-year supply of oil.

1916 – The U.S. Bureau of Mines warned about "a crisis of the first magnitude."

1940 – The U.S. Bureau of Mines predicted that the U.S. would exhaust its domestic oil reserves by 1954.

1969 – According to estimates, the state of Oklahoma had 125 million barrels of oil left in the ground. Over the next quarter-century, Oklahoma would produce 4.5 billion barrels of crude oil.

1972 – The Club of Rome estimated that only 550 billion barrels of oil remained in the earth. In just the last two decades, however, the world has used 600 billion.

1980 – Energy Secretary James Schlesinger announced that America's "energy future is bleak" and likely to grow bleaker. Schlesinger warned about "chronic stringency" in the decades ahead. By the mid-1980s, a worldwide glut of oil drove prices down from a high of over $60 per barrel to under $20 per barrel (2004 dollars). Prices remained under $30 per barrel (dropping to as little as $12) until 2004.

1997 – British oil analyst Colin Campbell predicted peak world production was just around the corner and claimed that the world was on the brink of war, starvation, and possible extinction.

MYTH 5 WE CAN MEET FUTURE ENERGY DEMAND THROUGH CONSERVATION AND EFFICIENCY

It is widely believed that by increasing the efficiency of automobiles, furnaces, appliances, air conditioners, and even lawn mowers, we can significantly reduce our national demand for energy. President Bush was only stating the perspective of the majority when he said as much in a 2005 speech.[9] At the President's direction, a high-level office in the Department of Energy spent over $700 million in 2006 to advocate energy efficiency and to promote renewable energy technologies.

Approximately seven in ten respondents queried in September 2006 said that they believe that we can satisfy our national demand for energy in the future solely by employing conservation and efficiency measures. That number was hardly different at all (66 percent) when Zogby International polled Americans five months later.

A belief in the power of efficiency is widespread across political lines. More than 240 members of Congress claim membership in either the House or Senate Renewable Energy and Energy Efficiency Caucuses. If there is one point of agreement when it comes to energy, it's that raising efficiency will lower consumption.

SURVEY RESPONSES

Can the U.S. Meet Its Future Energy Demand through Conservation and Efficiency?

	Feb. 2007	Sept. 2006
Agree	66	70
Disagree	27	26
Not sure	7	4

In practice, however, the evidence demonstrates otherwise. The history of the twentieth century is one of gigantic increases in efficiency—and even larger increases in consumption. The American economy has experienced massive efficiency gains: for each unit of energy, we produce more than twice as much GDP today than we did in 1950. Yet during that period of time, our national total energy consumption has tripled. Paradoxically, when it comes to energy, the more we save, the more we consume.

How and why can this be? Essentially, the cost of energy output has been spiraling downward—and lowering the cost per output of any activity will likely lead to more of it.

> "The history of the twentieth century is one of gigantic increases in efficiency—and even larger increases in consumption. . . Paradoxically, when it comes to energy, the more we save, the more we consume."

"Efficiency fails to curb demand because it lets more people do more, and do it faster—and more/more/faster invariably swamps all the efficiency gains," Peter Huber and Mark Mills state in *The Bottomless Well*. Or, as Huber characterized this "efficiency paradox" in a 2001 *Forbes* column: "More efficient jet engines … cheaper tickets … more passengers … more jets in the air." The same holds true for cars, lightbulbs, power plants, and everything else that uses energy.

Our demand for energy has increased, partially because our machines and our devices have all become much more efficient. Although efficiency advances might curtail demand in the short term for any particular activity, the long-term impact has always proven to be the opposite—and in the future this pattern will be repeated.

The U.S. Energy Information Administration forecasts that the United States economy will require about 30 more quads—or 30 percent more energy—in 2030 than it requires now. To put that gigantic figure in perspective, the entire American economy consumed a total of 32 quads in 1949.

"Although efficiency advances might curtail demand in the short term for any particular activity, the long-term impact has always proven to be the opposite—and in the future this pattern will be repeated."

Supplying the large amounts of raw power needed to drive economic growth is extremely different from relying on conservation and efficiency measures, which, by their nature, merely nibble on the edges of our current demand. Can further conservation and efficiency gains help Americans deal with future energy challenges? Yes, they certainly can. But can they serve as a substitute for the massive quantities of energy that our economy will require? Based on all evidence, that would seem impossible.

WHEN CONSERVATION IS INEFFICIENT...

As a general principle, more efficient devices are more efficient because they run faster. But faster devices get used more, deliver more miles, generate more electricity, weave more fabric, or reap more wheat.... Why are we repeatedly told that driving slowly "saves fuel"? It does, but only because it wastes time. Lowering the speed does indeed lower aerodynamic drag on the vehicle, but people drive faster for a reason—to get somewhere sooner. "Efficiency" is supposed to save fuel by doing the same job better; it is always possible to save fuel by doing less of a job, worse.

—*The Bottomless Well*, by Manhattan Institute Senior Fellow Peter Huber and Mark Mills

6. Three Mile Island Was a Deadly Nuclear Accident
7. Our Cities Are Becoming More Polluted
8. Logging and Development Are Shrinking Our Forests
9. Global Warming Has Accelerated in the Past Fifty Years
10. The Kyoto Protocol Requires All Countries to Reduce Greenhouse Gas Emissions

II. ENVIRONMENTAL MYTHS

MYTH 6 THREE MILE ISLAND WAS A DEADLY NUCLEAR ACCIDENT

Nuclear power is thought by many to be unsafe, in part because mildly enriched uranium, the chief fuel used in commercial nuclear power plants, is radioactive. Moreover, its use generates nuclear waste that can pose dangers. Coal, natural gas, and petroleum, by comparison, do not pose similar risks. Many Americans' fears about nuclear energy stem not just from concerns about the dangers of radioactive materials but from the near-catastrophe at Pennsylvania's Three Mile Island nuclear power plant in 1979. The accident, which involved a partial meltdown of the reactor's core, remains the worst accident that the American nuclear industry has ever experienced.

It is therefore surprising to many people to learn that no one died at Three Mile Island. In a test of the public's knowledge about what happened, our respondents were offered various possibilities as to the number of people killed as a result of the accident. Almost 45 percent of respondents were "not sure," which suggests some uncertainty in the public's mind about the nature of the accident. Only about one in six respondents answered, correctly, that the accident resulted in no fatalities. Nearly 12 percent thought that more than a hundred people died. Almost 10 percent of respondents put the figure at 27 deaths.

SURVEY RESPONSES

How many people died in the Three Mile Island nuclear accident in 1979?

	Percent
Not sure	44.7
None	16.9
117	11.9
27	9.8
3	8.5
Other/none of the above	8.2

Of course, people's opinions about nuclear energy are informed by more than just Three Mile Island. The 1986 accident at the Chernobyl nuclear plant in the former Soviet Union helped harden opposition to nuclear energy in some quarters, particularly in Europe. Unlike Three Mile Island, Chernobyl actually claimed lives. Several dozen people died in the first few months after the accident, and the region had to be permanently evacuated. Perhaps 4,000 people eventually will die from radiation-induced cancers tied to the disaster, according to a recent United Nations report.[10]

The chief lesson to draw from the Three Mile Island and Chernobyl incidents is not that nuclear power is fundamentally unsafe. Instead, it would seem that nuclear power is safe, with the proper safeguards in place. The difference between the two incidents bears out this conclusion. Three Mile Island's concrete containment structures—airtight structures made of steel-reinforced concrete—did what their name suggests: they contained the accident, ensuring that deadly radiation did not escape into the atmosphere. Chernobyl, on the other hand, like most Soviet-era reactors, did not have containment facilities. The tragedy of Chernobyl was not the initial accident but that nothing was in place to stop the release of radiation. Chernobyl reveals more about the dangers of Soviet-style Communism than it does about nuclear energy. As Mark Mills notes, "The Soviet empire … would have been hard-pressed to make a viable toaster oven." Unlike commercial nuclear plants in the United States, the Chernobyl reactor was designed to produce weapons-grade material in addition to electricity. Its inherent design instability and lack of safety features practically made an accident inevitable; its lack of a containment structure guaranteed that an accident would become catastrophe.

Given the great benefits of nuclear energy, journalists and policymakers need to understand the facts. As demonstrated in the following charts, nuclear energy in America has a track record of safety.

In over a half-century of commercial nuclear power generation, not one person has died as a consequence of an accident at an American nuclear plant. Still, given the dangerous nature of nuclear materials, people naturally have concerns about the presence of a nuclear power plant in their community.

NUCLEAR PLANT SAFETY

The U.S. Nuclear Regulatory Commission, which monitors nuclear plant safety, keeps statistics on "Significant Events" at the United States' 103 commercial nuclear power plants. Examples of Significant Events" include a reactor shutting down with complications, the degradation of critical safety equipment, and an unplanned, excessive release of radioactivity. The average number of Significant Events per reactor was 89 percent lower in 2004 than in 1990.

Year	Avg. No. of Significant Events per Reactor
1990	.45
1991	.40
1992	.25
1993	.26
1994	.21
1995	.17
1996	.08
1997	.10
1998	.04
1999	.03
2000	.02
2001	.07
2002	.05
2003	.07
2004	.04
2005	.05

Source: U.S. Nuclear Regulatory Commission, Information Digest 2006–07

TABLE 3. How Much Is Too Much Radiation?

According to the U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency, the average American is exposed to 300 millirem of radiation from natural sources each year and an additional 60 millirem from man-made sources. What sort of annual exposure do residents of a community near a nuclear power plant receive, and how does it compare with that from other activities?

Full set of dental X-rays	40 millirem
Chest X-ray	8 millirem
Round-trip flight from D.C. to L.A.	5 millirem
Annual radiation from television	1 millirem
Living outside nuclear power plant	0.10 millirem
Living within 50 miles of a nuclear power plant	0.009 millirem
Living with smoke detector in home	0.008 millirem

Sources: U.S. Nuclear Regulatory Commission Fact Sheet, "Biological Effects of Radiation"; and U.S. Environmental Protection Agency, online worksheet for students and teachers, "Calculate Your Radiation Dose"

MYTH 7 OUR CITIES ARE BECOMING MORE POLLUTED

SURVEY RESPONSES

Are Our Cities Becoming More Polluted?

	Percent
Yes	83.7
No	13.5
Not sure	2.8

Most of us believe that increased energy use inevitably harms the environment. More than 83 percent of respondents replied that they believe that our cities are becoming more polluted as a result of our increased energy use. And why shouldn't they believe this? More energy use means increased economic growth and greater industrial production. Add to that a 38 percent increase in U.S. population, and it also means more coal and gasoline burned and more miles driven or flown. Indeed, from 1970 to 2002, Americans' total energy consumption rose by more than 40 percent, including 543 million extra tons of coal per year and an additional 5.4 million barrels per day of oil for our cars, trucks, and planes.

But here is a fact that most people don't know: pollution has been cut nearly in half over this period, despite rising energy consumption and an expanding economy. According to the Environmental Protection Agency's 2003 *Air Quality and Emissions Trends Report*, which looked at the period from 1970 to 2002, "Aggregate emissions of the six principal pollutants have been cut 48 percent. During that same time, U.S. gross domestic product increased 164 percent … and vehicle miles traveled increased 155 percent."

Journalist Gregg Easterbrook took note of these trends in The Progress Paradox: "Since 1970, smog has declined by a third, even as the number of cars has nearly doubled and vehicle-miles traveled have increased by 143 percent; acid rain has declined by 67 percent, even though the United States now burns almost twice as much coal annually to produce electric power; airborne soot particles are down, which is why most cities have blue skies again; airborne lead, a poison, is down 97 percent."[11]

How to explain this seeming paradox—more energy use by more people, but less overall pollution? Part of the answer may lie with the pollution controls codified in the Clean Air Act of 1970. Some observers, though, argue that air quality in the United States had been improving substantially even before the passage of that landmark legislation and that a combination of advanced technologies and state and local laws would have guaranteed continued improvement in air quality even without the federal government's regulatory involvement. Whatever the reason, there is little doubt that by most measures (clean air being just one), America's environment is cleaner today than it was several decades ago.

TABLE 4. Comparison of 1970 and 2002 Emissions

Carbon Monoxide (CO)	-48%
Nitrogen Oxide (NOx)	-17%
Sulfur Dioxide (SO_2)	-52%
Particulate Matter (PM_{10})	-34%
Lead (Pb)	-98%
Volatile Organic Compounds (VOC)	-51%

Note: The first five are among the six criteria pollutants for which EPA establishes air-quality standards under the Clean Air Act. The sixth pollutant, ozone, is not directly emitted but instead forms when volatile organic compounds interact with oxides of nitrogen in the presence of sunlight.

Source: Environmental Protection Agency

Many who acknowledge the improvements in air quality are often quick to credit the federal Clean Air Act (CAA), passed in 1970 and amended several times since. The CAA costs the economy more than $20 billion each year, according to Environmental Protection Agency estimates. Critics claim that the costs are significantly higher. In any event, the jury is still out as to what degree the CAA is responsible for cleaner air. Though we have seen significant improvements in air quality since 1970, those improvements were under way before the law went into effect. To a large degree, these improvements are the result of advancements in automotive technology independent of federal regulations.

LOGGING AND DEVELOPMENT ARE SHRINKING OUR FORESTS 8 MYTH

As with air pollution, the public is inclined to believe that economic expansion impedes environmental stewardship. Fully two-thirds of respondents signaled that they believe one consequence of human activity, such as logging or development, is that America's forests are shrinking.

SURVEY RESPONSES

Is Human Activity, Such as Logging or Development, Shrinking Our Forests?

	Percent
Yes	66.6
No	28.9
Not sure	4.4

Numbers do not total 100% because of rounding by Zogby.

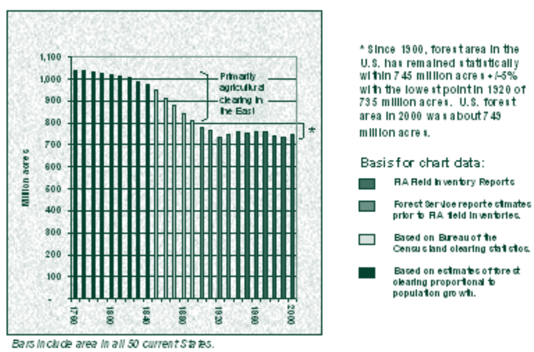
In reality, our footprint over nature appears to be shrinking. One of the most positive environmental trends in the United States during the course of the twentieth century was the tendency to need smaller and smaller amounts of space to provide the necessities of life. At the advent of the twentieth century, machines began to replace work animals (and the food they require) on farms. Subsequent chemical innovations helped drastically increase agricultural yields. The result, as Rockefeller University professor Jesse Ausubel notes, is that "in the United States in 1900 the protein or calories raised on one Iowa hectare fed four people for the year. By the year 2000 a hectare … could feed 80 people for the year."[12]

At the same time that we have needed less farmland while still growing more food, we have also required less wood. The U.S. population grew by over 250 percent during the twentieth century, but total timber consumption rose by only 70 percent over the course of the century, thanks to steel and concrete replacing wood for a variety of applications. The typical American today consumes only half the timber for all uses that he did a century ago.

As a result of these developments, the deforestation of the American continent that marked the pre-industrial period came to an abrupt halt early in the twentieth century. About 300 million acres of forestland were lost between 1630 and 1920. Most of that forestland had been cleared for agriculture. Yet despite significant increases both in population and in agricultural output during the twentieth century, in 2002 the Forest Service reported that "the total area of forestland has been stable for nearly 100 years."[14]

The trend in recent years is even more encouraging. According to the Forest Service's Forest Inventory and Analysis program, we have actually witnessed slight reforestation, or over 5 million net acres since 1985.[15] We harvested roughly 80 million more acres of cropland sixty years ago than we harvest today; most of this land is on its way to reforestation. We have "re-treed" at least 10 million acres since 1987 alone."[16] Between 2000 and 2005, the United States experienced the fourth-largest average annual net gain of forest area on the planet.[17]

For the first time in history, a Western nation has halted, and is now rapidly reversing, the decline of its woodlands.



Source: U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis, "Trend Data"

FIGURE 2. Forest Area, 1760–2000

MYTH 9 GLOBAL WARMING HAS ACCELERATED IN THE PAST FIFTY YEARS

Since the beginning of the Industrial Revolution in the mid-eighteenth century, human activities have added a considerably larger share of heat-trapping greenhouse gases to the atmosphere than during any previous era.[18] For that reason, discussion of global warming has emphasized the role that these activities—notably, coal combustion for electricity generation and oil combustion for transportation—may play in climate change. It is not surprising, then, that more than three-quarters of respondents believe that the planet warmed more during the latter half of the twentieth century, when global energy consumption was greater and fossil-fuel combustion was much higher.

SURVEY RESPONSES

During Which Twentieth-Century Period Did the Earth Warm the Most?

	Percent
1951 to 2000	78.3
1900 to 1950	13.4
Not sure	8.4

Numbers do not total 100% because of rounding by Zogby.

Nevertheless, scientists generally believe that the earth warmed at least as much, if not more, from 1900 to 1950 than during the subsequent fifty years. Indeed, the global climate pattern saw a relatively pronounced rise in temperatures from shortly after the turn of the century to about 1945. Then temperatures cooled somewhat until 1976, when they began to rise again with slightly more acceleration.[19]

To what degree are human-induced greenhouse gases responsible for warming the atmosphere? The answer is unclear. Despite the certitude with which the media and politicians treat the issue, the science remains muddled. Temperatures fluctuate: they go up in some regions, down in others, and may be affected by naturally occurring phenomena, such as *El Niño*.

There are some—most notably, former vice president Al Gore—who argue that the climate fluctuations of the twentieth century are due to greenhouse gas emissions, particularly carbon dioxide generated by burning fossil fuels. But other observers are not so sure. According to the George C. Marshall Institute, "Much of the

"To what degree are human-induced greenhouse gases responsible for warming the atmosphere? The answer is unclear."

observed temperature rise of 0.5°C [approximately 1°F] occurred before 1940, whereas most of the additional carbon dioxide (over 80 percent) entered the atmosphere after 1940.... The increase in greenhouse gases cannot explain the rapid rise in temperature prior to 1940, and it cannot explain the drop in temperature from 1940 to 1970.... Natural factors must have caused most of that [early-twentieth-century] warming."[20]

In their book *Energy: The Master Resource*, Robert L. Bradley, Jr. and Richard W. Fulmer raise an interesting point about the supposed impact of carbon dioxide as the principal agent of climate change: "The most common greenhouse gas is water vapor, which accounts for about 94 percent of the natural greenhouse effect. Its atmospheric concentration is ten times that of CO2. Water vapor's impact on the climate is complex and not well understood. It can both warm and cool the atmosphere."[21]

The lack of certainty that surrounds the climate-change debate was underscored in December 2006, when Britain's *Sunday Telegraph* reported that the United Nations Intergovernmental Panel on Climate Change (IPCC) was preparing to reduce its overall estimate of mankind's impact on climate change by as much as 25 percent. The story also noted that the IPCC had already "been forced to halve its predictions for sea-level rise by 2100, one of the key threats from climate change."[22]

THE KYOTO PROTOCOL REQUIRES ALL COUNTRIES TO REDUCE GREENHOUSE GAS EMISSIONS 10 MYTH

Supporters of the Kyoto Protocol, most particularly former vice president Al Gore, tout it as the optimal international mechanism to curb global warming.[23] The idea behind it, we are told, is that it binds everyone to work together to reduce greenhouse gas emissions. This notion has taken hold in the popular consciousness. Roughly 60 percent of respondents to the MI/Zogby survey indicated that they believe that the Kyoto treaty requires all countries to cut their emissions of greenhouse gases.

SURVEY RESPONSES

Would the Kyoto Protocol Require All Countries to Cut Greenhouse Gas Emissions?

	Percent
Yes	59.9
No	19.3
Not sure	20.8

In fact, the Kyoto Protocol does not require every nation to reduce its greenhouse gas levels. Overall, Kyoto requires developed nations to reduce emissions by a total of 5 percent by 2012, but the reductions negotiated by particular treaty participants vary according to each signatory's situation. Several nations actually are permitted increases in their greenhouse gas emissions from 1990 levels, while others are allowed to maintain the same levels. Perhaps most objectionable is the treatment received by signatories China and India: despite contributing huge stores of carbon dioxide to the atmosphere, both nations are exempt from making any reductions. In fact, greenhouse gas emissions from China, India, and other developing countries will likely "account for most of the global increase in carbon dioxide emissions over the next quarter-century."[24] The International Energy Agency projects that China will lead the world in emitting carbon dioxide, the chief greenhouse gas linked to global warming, by 2009.[25]

Public ignorance about the Kyoto Protocol has allowed treaty proponents to assume the moral high ground, singling out the United States for refusing to comply with its obligations under the treaty, which was signed by Vice President Al Gore in 1998 but never submitted to the Senate for approval. (The first phase of the treaty would require the United States to cut its greenhouse gas emissions during the 2008–12 time frame to a level that is 7 percent lower than the amount emitted in 1990.)

TABLE 5. Select Country-by-Country Greenhouse Gas Emissions Targets under the Kyoto Protocol

Targets for 2008–12 are compared with 1990 baseline levels, e.g., Australia is permitted to increase its emissions by 8 percent over 1990 levels, while Japan is required to cut its emissions by 6 percent.

Country	2008-2012 Kyoto Target level	Change from 1990 baseline
Australia	108%	8% increase
Canada	94%	6% decrease
China	exempt	n/a
France	92%	8% decrease
Germany	92%	8% decrease
India	exempt	n/a
Japan	94%	6% decrease
New Zealand	100%	none
Norway	101%	1% increase
Poland	94%	6% decrease
Russia	100%	none
Spain	92%	8% decrease
United Kingdom	92%	8% decrease
United States	93%	7% decrease

Sources: CNN.com; and United Nations Framework Convention on Climate Change

III. OPEN QUESTIONS AND OVERLOOKED REALITIES

11 IS AMERICA "ADDICTED TO OIL"?

In perhaps the most memorable line of his 2006 State of the Union address, President Bush announced that "America is addicted to oil." The line was as notable for its frankness as for the fact that it was uttered by a former oil-industry executive. The president proposed a host of alternative-energy research programs to deal with this dependency. Eighty-three percent of initial survey respondents agreed with the president's assessment of the nation's energy situation. In the wake of the president's 2007 State of the Union address, in which he repeated several themes from his 2006 speech, the percentage of respondents believing that our nation is addicted to oil was virtually unchanged (84 percent). But is that assessment correct?

SURVEY RESPONSES

Is America Addicted to Oil?

	Percent
Yes	83.0
No	14.3
Not sure	2.6

Figures do not total 100% because of rounding by Zogby.

As we learned in the first section of this report, oil is a much less dominant player in our energy economy than most people think. It does not even provide the majority of the energy that we use, supplying 40 percent of energy consumption.[26] The rest of the energy economy—60 percent—is accounted for by sources that, for the most part, provide electricity: coal, natural gas, nuclear power, and renewable energies such as hydropower, biomass, wind, and solar. Given the diversity that defines the American energy economy, it is misleading to say that the United States is "addicted" to oil.

Certainly, our use of oil creates problems. The transfer of billions of dollars to foreign suppliers in Saudi Arabia, Iran, and Venezuela troubles many of us. Burning nearly 7 billion barrels of oil per year, mostly to power our cars, trucks, and airplanes, also raises environmental concerns.

> "Given the diversity that defines the American energy economy, it is misleading to say that the United States is 'addicted' to oil."

But for all the problems associated with our oil use, it is important to note the tremendous benefits that it has provided to the United States: oil has helped to underpin the most dynamic and productive economy that the world has ever known. Moreover, by powering our transportation sector, it has afforded Americans a measure of personal mobility still unknown throughout most of the rest of the world.

Yet if we are not addicted to oil per se, are we not dangerously reliant on foreign oil? In characterizing America as "addicted" to oil, President Bush tapped into widely shared concerns about the suppliers of our energy. We repeatedly hear that America is a net importer of petroleum. Understandably, the vast majority of us believe that the U.S. is overly dependent on foreign oil.

SURVEY RESPONSES

Is the U.S. Overly Dependent on Foreign Oil?

	Percent
Yes	87.5
No	11.2
Not sure	1.3

Nearly 88 percent of respondents indicated that they thought that the U.S. was overly dependent on foreign oil in September 2006, at the tail end of a summer in which the price of oil had gone to record highs (in nominal dollars). By February 2007, the price had fallen nearly 20 percent off those 2006 highs; yet the same percentage still indicated a belief that our economy is overly dependent on imported oil.

It is true that we get nearly 60 percent of the petroleum that we use from other nations—but as we saw above, fully two-thirds of the oil that we use comes not from the Middle East but from the Americas. Examining that other 40 percent fills out the picture: the U.S., it turns out, is its own largest individual supplier of petroleum products. About 40 percent of the crude oil and refined products that we use—more than 7 million barrels daily—comes from domestic sources, mostly in Texas, Alaska, California, and Louisiana.

What, one may ask, about the Organization of Petroleum Exporting Countries? We often hear that the OPEC cartel controls world energy markets and, in particular, wields influence over the United States. The OPEC nations, which include not just the major Middle Eastern suppliers but also hot spots Venezuela and Nigeria, provide the United States with more than 5.5 million barrels of oil per day, over a quarter of what we use and over 40 percent of all petroleum imports to the U.S.

"This diversity of suppliers for the United States, combined with increased production from non-OPEC nations, gives the American economy an extra measure of security that it did not have three decades ago."

While OPEC member countries do wield influence in world energy markets, that influence—both in the United States and around the globe—has waned somewhat in the several decades since the oil shocks of the 1970s. During the late 1970s, OPEC accounted for two-thirds of petroleum imports to the United States. Today, the figure is closer to two-fifths. And while we consume in the aggregate 17 percent more petroleum than we did in the late 1970s, our reliance on OPEC for our oil has lessened: OPEC imports to the United States today are slightly less as a percentage of total U.S. consumption (28.6 percent for 1975–80 vs. 26.9 percent in 2005) and considerably less as a percentage of imports (66.5 percent for 1975–80 vs. 43.5 percent in 2005).

The primary reason for OPEC's diminished influence is that the rest of the world is producing more oil, even as U.S. oil production has fallen. The United States produces roughly one-fifth less petroleum domestically than it did in the late 1970s. Over that same period, the OPEC nations have increased production by 15 percent. But the main story in world oil markets is greatly increased production elsewhere on the planet. During the late 1970s, non-OPEC countries (excluding the U.S.) accounted for 36 percent of the world's daily oil supply. Today, those countries' share has risen to 50 percent. By contrast, OPEC, which supplied about half the world's oil during the 1970s, now supplies but two-fifths. This diversity of suppliers for the United States, combined with increased production from non-OPEC nations, gives the American economy an extra measure of security that it did not have three decades ago.

None of this is to say that OPEC does not wield considerable influence over world energy markets. The cartel's member countries obviously have the capability to affect output and world petroleum prices to a degree unparalleled by any other producer. Yet, given the trends of recent decades and considering that oil trades in a world market, regimes such as Saudi Arabia and Venezuela do not have the stranglehold over the U.S. economy that some suggest. For those reasons, attempts by OPEC or its members to employ an "oil weapon" are likely doomed to fail, as the world saw in the 1970s (see box). To cause grave damage to the U.S. and the world economy, OPEC would likely have to withdraw its oil from the market and cease all oil sales, which naturally requires cutting off its members' chief source of revenue.

OPEC'S FAILED 1973 OIL EMBARGO

Contrary to what many noneconomists believe, the 1973 [oil] price increase was not caused by the oil "embargo" (refusal to sell) directed at the United States and the Netherlands that year by the Arab members of OPEC. Instead, OPEC reduced its production of crude oil, thus raising world oil prices substantially. The embargo against the United States and the Netherlands had no effect whatever: both nations were able to obtain oil at the same prices as all other nations. The failure of this selective embargo was predictable. Oil is a fungible commodity that can easily be resold among buyers. Therefore, sellers who try to deny oil to buyer A will find other buyers purchasing more oil, some of which will be resold by them to buyer A.

Nor, as is commonly believed, was OPEC the cause of oil shortages and gasoline lines in the United States. Instead, the shortages were caused by price and allocation controls on crude oil and refined products, originally imposed in 1971 by President Nixon as part of the Economic Stabilization Program.

—Manhattan Institute Senior Fellow Benjamin Zycher, *The Concise Encyclopedia of Economics*.

12 WHICH ENERGY SOURCE IS THE SAFEST TO PRODUCE AND USE?

The responses to this question suggest that conventional wisdom has settled around the relative dangers of various sources of energy. Two of every three respondents think that renewable energies such as wind, solar, and hydropower are the safest to produce and use.

SURVEY RESPONSES

Which Energy Source Is the Safest to Produce and Use?

	Percent
Renewables	67.7
Oil	7.9
Nuclear	7.7
Natural gas	7.4
Coal	3.6
Not sure	3.6
Other/none	2.1

In truth, every energy source has dangers and risks. Nuclear power relies on radioactive materials that are potentially lethal if handled imprudently. Coal is dangerous to scoop out of underground mines, as demonstrated by the 2005 tragedies in West Virginia and Kentucky that claimed more than a dozen lives. Petroleum entails such hazards as oil spills and explosions. Fossil-fuel combustion, meanwhile, is believed to contribute to global warming.

Renewable energy technologies are not completely safe, either. Hydroelectric dams kill fish, divert rivers, and threaten ecosystems with soil erosion. Congressional opponents of a proposed offshore New England wind farm have suggested that its turbines would disrupt the navy's sonar, putting our national security at risk. And while the operation of solar panels is eminently safe, their manufacture requires mining huge quantities of materials and refining them in ways that release toxins and metals into the atmosphere.

All else being equal, renewables are in some respects safer than conventional alternatives such as nuclear energy or coal from the standpoint of generating power; the gentle breeze or the noonday sun will always be less dangerous than an exposed uranium rod. But all else isn't equal.

When contemplating the relative safety of energy production and use, we should also consider the relative benefits. A nuclear power plant may use materials that are more dangerous and require greater security than a wind farm, but it will also produce vastly more power. Overall, the enormous benefits derived from nuclear power—which, pound for pound, outweigh those of any other fuel or energy technology—make it worth the risk.

The same goes for coal. Not only is coal dangerous to mine, but its use poses dangers to the environment in the form of pollution and greenhouse gas emissions. Still, coal, which produces half the nation's electricity, is so economical and reliable that its critics have not been able to offer realistic alternatives. Wind and solar energy presently are incapable of meeting even one-fiftieth of the generating capacity that we get from coal. The long lead time and capital-intensive process required to build new nuclear power plants mean that the nuclear industry won't have the capacity to match coal anytime soon. Available domestic natural gas reserves have plateaued, imperiling that fuel's present position, supplying a fifth of our electricity. The only alternative in the United States to using coal is using less electricity. That would result in rationing, decreased economic productivity, lower standards of living, and less freedom—which is not a realistic alternative at all.

13 WHICH SOURCE OF ENERGY CAUSES THE MOST DAMAGE TO THE ENVIRONMENT?

It's understandable that Americans believe coal and oil to be the most environmentally damaging energy sources. Burning fuels in power plants, factories, and vehicles leads to pollution and greenhouse gas emissions. Wind and solar power, by contrast, seem more "natural" and therefore more environmentally friendly. Hydropower appears to be the only renewable energy technology with significant environmental drawbacks.

SURVEY RESPONSES

Which Source of Energy Causes the Most Damage to the Environment?

	Percent
Coal	35.9
Oil	33.3
Nuclear	18.8
Not sure	5.0
Natural gas	4.2
Other/none	2.2
Renewables	0.5

Figures do not total 100% because of rounding by Zogby.

But our "unsafe" sources of energy are getting safer. Legislation now requires industries to limit pollutants, and research is under way to produce a variety of "clean coal technologies,"[27] which are gaining in prevalence.

Clean coal is worth a closer look. A power plant burning coal or natural gas may seem less environmentally friendly than the solar panels installed on a building's roof. But the power plant will provide power for an entire community, not just one building. In fact, coal may be a key to saving the environment.

In his book *An Inconvenient Truth*, former vice president Al Gore states that 30 percent of global carbon dioxide emissions—the main greenhouse gas associated with global warming—are a result of wood fires used for cooking in parts of the world without access to electricity. Though Gore failed to follow up on this point, Iain Murray of the Competitive Enterprise Institute notes: "If we introduced affordable, coal-fired power generation into South Asia and Africa we could reduce this considerably and save over 1.6 million lives a year." We might say the same for nuclear power. It produces no gases suspected of causing global warming and no gases that could cause ground-level ozone formation, smog, or acid rain.[28]

DOES ENERGY EXPLORATION ENDANGER ALASKAN WILDLIFE? 14

Concerns about Alaskan wildlife have stalled proposals to exploit oil reserves in the Arctic National Wildlife Refuge (ANWR). Memories of the 1989 Exxon Valdez oil spill provide many conservationists with cause for worry.

SURVEY RESPONSES

Does Energy Exploration Endanger Alaskan Wildlife?

	Percent
Yes	53.5
No	36.9
Not sure	9.5

Figures do not total 100% because of rounding by Zogby.

Yet the experience of oil exploration at nearby Prudhoe Bay suggests that drilling need not endanger wildlife. When oil exploration began in the 1970s, an estimated 3,000 caribou roamed in the central Arctic herd in Prudhoe Bay. At the time, conservationists raised concerns, similar to those voiced today, about the dangers that drilling might pose to the caribou and other wildlife. In the three decades since, however, the caribou herds multiplied more than tenfold, to an estimated 32,000. Similarly, studies of local polar bears have found no adverse effect on their population from energy exploration and production.

Another argument against opening a portion of the ANWR in Alaska to energy exploration is that "there is not enough oil in ANWR to make a difference," as Congressman Roscoe Bartlett (R-MD) stated. How much is enough to "make a difference"? The United States Geological Survey estimates that ANWR holds 5.7 to 16 billion barrels of recoverable reserves, with a mean estimate of 10.4 billion barrels. Those estimates, from over five years ago, assume the use of older drilling technology. According to the House of Representatives Committee on Resources, that mean estimate of 10.4 billion barrels is "more than twice the proven oil reserves in all of Texas … [and] almost half of the total U.S. proven reserves of 21 billion barrels."[29] Former energy secretary Spencer Abraham notes that this figure could "offset seven years of oil imports from all of OPEC and nineteen years of oil imports from Saudi Arabia."[30]

Conservative estimates indicate that ANWR could produce one to 1.4 million barrels of oil every day for thirty years. The United States consumes about 20 million barrels of oil each day, importing 12 million or so. ANWR's expected minimum of a million barrels per day would seem to make enough of a difference to be worth the effort. With existing domestic oil sources beginning to wane, preventing exploration in ANWR and other areas is a potentially irresponsible policy move.

15 THE ETHANOL ILLUSION

For years, presidential candidates wooing Iowa caucus voters have promoted ethanol, a fuel produced from corn, as a homegrown alternative to foreign oil. In his 2006 and 2007 State of the Union addresses, President Bush pointedly endorsed ethanol (and other biofuels—in particular, cellulosic ethanol, made from sources such as agricultural waste) as a key component in reducing our "addiction to oil." The administration's commitment of research dollars and federal subsidies has further heightened public interest in ethanol as an alternative to gasoline.

Is all this attention justified? As we have seen in earlier sections, all fuels are not created equal, and the same goes for ethanol. As a plurality of Americans correctly believe, the energy content in ethanol is considerably lower than in gasoline.

SURVEY RESPONSES

Does a Gallon of Ethanol Contain More, Less, or the Same Amount of Energy as a Gallon of Gasoline?

	Feb. 2007	Sept. 2006
Less energy	29	35
The same amount of energy	20	26
More energy	14	18
Not sure	37	21

Consumer Reports finds that E85 (a blend of 85 percent ethanol and 15 percent gasoline) provides 27 percent less fuel economy than pure gasoline.[31] The drop-off is even more significant with pure ethanol. "Conventional gasoline without ethanol contains about 115,000 Btu in a gallon," according to the U.S. Energy Information Administration. "Ethanol contains 76,000 Btu in a gallon, or about two-thirds the energy of gasoline."[32]

Because ethanol is so much less efficient than gasoline, the several billion dollars in subsidies that governments annually provides to ethanol R&D and production have done virtually nothing to increase ethanol's share in our energy mix. Nevertheless, policymakers still champion ethanol as a surrogate for gasoline. The 2005 Energy Policy Act mandates the use of 7.5 billion gallons of renewable and alternative fuels in the U.S. energy supply by 2012. In his 2007 State of the Union address, President Bush proposed increasing that mandate nearly fivefold by 2017.

Interestingly, respondents to the MI/Zogby follow-up survey who were asked about ethanol in the wake of President Bush's 2007 proposal seemed more confused by the topic than those queried five months before. Whereas 21 percent of initial respondents indicated that they were unsure about the relative energy differences between gasoline and ethanol, that figure grew to 37 percent of respondents in the follow-up survey.

Undeterred by ethanol's poor performance relative to gasoline, Congress inserted a provision into the Energy Policy Act of 2005 requiring that by 2012, at least 7.5 billion gallons per year of renewable fuels (chiefly ethanol, but also including biodiesel) be blended into the nation's fuel supply. Since ethanol contains about one-third less energy than gasoline, the mandated figure should offset roughly 5 billion gallons of gasoline, or the equivalent of 120 million barrels of oil. That's equal to about nine days' worth of current imports.

Sources: U.S. Department of Energy, "On the Road to Energy Security: Implementing a Comprehensive Energy Strategy," August 2006, p. 10; and U.S. Energy Information Administration, "Energy Basics 101," http://www.eia.doe.gov/basics/energybasics101.html

16 RENEWABLE ENERGY SOURCES

As a solid majority of survey respondents correctly answered, the renewable technologies wind and solar power provide the smallest amount of America's energy of the options given.

SURVEY RESPONSES

Which Source Provides America with the Least Energy?

	Percent
Wind and solar	60.9
Coal	15.6
Nuclear	9.6
Natural gas	5.7
Not sure	3.8
Other/None	3.2
Oil	1.2

As Table 1 shows, renewable energy technologies account for 6 percent of U.S. primary energy consumption.

What is surprising about the relatively small role that renewable energies play in our energy economy is the large measure of taxpayer dollars that they have received. Since 1970, renewable technologies have received over $20 billion in federal government subsidies to spur their development and market application.[33] Despite this largesse, they have been unable to compete economically with far cheaper and more reliable options such as coal and nuclear power. Of all renewable technologies, wind and solar receive the most attention from the public, despite their fairly dismal performance. Taken together, wind and solar today account for just one-fifth of 1 percent of America's annual energy consumption.

Advocates of these technologies generally make two arguments in their favor. First, by harnessing the power and cycles of nature, they rely on fuels whose supplies are seemingly inexhaustible (hence renewable), unlike finite resources such as petroleum or coal. Second, renewables arguably have a less adverse impact on the environment than traditional carbon-based energy sources. (Hydroelectric power, however, has fallen out of favor with many environmentalists because of the ecological side effects of damming rivers. Traditional proponents of renewable energies, such as Greenpeace and the Natural Resources Defense Council, tend to promote all renewable energy technologies except hydropower.) Non-hydro renewables account for 3.35 percent of total U.S. energy consumption, or about half of renewable energies' total. The largest share of that small figure is derived from energy from biomass, such as wood, waste, and alcohol fuels like ethanol.

TABLE 6. Renewable Energy's Share of Total U.S. Energy Consumption, 2004

Renewable energy technologies account for 6.2 percent of U.S. energy consumption in 2004. Here's how it breaks down:

	% of U.S. Energy Consumption
Hydropower	2.67
Biomass	2.97
Geothermal	0.34
Wind	0.14
Solar	0.06

Source: U.S. Energy Information Administration, Annual Energy Review 2005

Given the expected jump in energy demand, it seems unlikely that renewables—particularly such poor performers as wind and solar—will play more than a niche role. The solar, wind, and geothermal industries would have to experience massive growth over the next twenty-five years just to maintain their current small share in our energy mix.

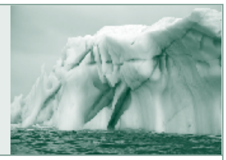
The disadvantages of renewables may best be understood by examining the punch that they pack versus the space that they require. Wind turbines require huge tracts of land to be set aside in order to generate meaningful amounts of power. To generate the electricity that a typical 1,000-megawatt coal-fired or nuclear power plant produces would require a utility-scale wind plant using 60,000 acres[34] of land.[35] Similarly, it would take about 11,000 acres of photovoltaic cells to generate the same amount from solar energy.[36]

Comparing fuel density provides an even better contrast. Biomass has far less energy density than other fuels. Pound for pound, coal stores twice as much energy as wood. On the same comparison, oil is twice as energy-dense as coal; it packs the same amount of energy into half the weight and space. Nuclear power, though, wins this test by a landslide. A single gram of uranium-235 packs the same punch as four tons of coal or eight tons of wood.

Wind and solar energy, moreover, are not constant. The wind does not always blow, and the sun does not always shine. Nuclear reactors, coal furnaces, and gas-fired plants, on the other hand, can produce electricity virtually around the clock, using far less space.

In certain instances, wind, solar, and other renewable energies can contribute to the energy mix of a particular region or business. High-plains states like Nebraska, Kansas, and Montana, with wide, flat spaces but sparse populations, are good candidates for wind farms, whose turbines can exceed 100 meters in height. The sun-drenched southwestern United States is a better candidate for solar power than the rest of the continental U.S., where sunlight is more intermittent. Still, it is unlikely that renewables can produce more than a tiny fraction of the additional 1.774 trillion kilowatt-hours of energy that our economy will require each year by 2030.[37]

REALITIES AND UNCERTAINTIES OF GLOBAL WARMING 17



Despite contentiousness often surrounding the global-warming debate, scientific consensus is that the planet is warming, thanks to data from numerous thermometer readings and satellite records.

Given highly publicized worries about melting ice caps, increasing hurricane activity, and rising sea levels, one wonders how much the planet has warmed. When asked how much the planet warmed during the twentieth century, a plurality (28 percent) of respondents correctly answered that global average temperatures increased by about 1 degree Fahrenheit.[38]

SURVEY RESPONSES

How Much Has the Planet Warmed in the Last Century?

	Percent
About 1°F	28.2
About 2°F	20.7
About 5°F	17.2
Not sure	14.7
About 10°F	8.0
Other/None	5.8
About 7°F	5.4

How concerned should we be about this increase? Evidence suggests that climate and temperatures greatly fluctuated for thousands of years prior to the Industrial Age; known causes include alterations in the earth's orbit, changes in the sun's intensity, and volcanic eruptions. Scientists believe that changes in the earth's orbit, which occur over periods of thousands of years, are the most significant cause of ice ages. Changes within the sun affect the intensity of the sunlight that warms the earth; and volcanoes emit carbon dioxide and aerosols into the atmosphere when they erupt.

Recent evidence has suggested that human activity contributes to climate change as well, through heat-trapping gas emissions and through pollution from aerosols and soot particles.[39] Carbon dioxide, a greenhouse gas, can cause warming and aerosol emissions can cause short-term cooling by blocking sunlight.[40]

Two points regarding global warming are often overlooked. First, accounts of climate change convey a sense of certitude that is probably unjustified. "Scientists are all but unanimous—on the inevitability of global cooling—in 1975," Peter Huber notes. "And almost unanimous again—on the inevitability of global warming—in 1992.… Yet the cooling/warming flip is quite typical of the business."[41] Second, the best "solutions" to global warming may not be the ones we expect. Recycling, for instance, may do far less to counter global warming than simply putting garbage in landfills (see sidebar).

Measuring the earth's average surface temperature over the course of a century is not easy. Measurements vary depending on where and when they are taken. Gauging average temperatures for the entire planet over one year requires averaging temperatures recorded at many points. Data must be accrued from thousands of thermometers at land stations, as well as on ships, in addition to more recent—and more accurate—satellite records.

SHOULD WE RECYCLE CARBON—OR BURY IT?

University of Nebraska professor Craig S. Marxsen calculates that "appropriately constructed landfills could capture roughly 2 billion tons of carbon annually, right now, and virtually stop global warming cold in its tracks."

About two-thirds of what we put in landfills is carbon based. And buried in a modern landfill, the carbon goes … nowhere. It doesn't rot. The landfills are well compacted, and their contents stay dry. They are not composters; they are mummifiers.

By mummifying carbon, we simply complete the carbon cycle. For a society that is consuming 70 quadrillion BTU of fossil-fuel energy every year, there is only one honest way of "recycling" carbon wastes, and that is to put them back where most of the carbon we use came from, deep underground.

The notion that "there is no room" down there is absurd. If we take old carbon out of the ground, we can put new carbon back in.…

With rare exceptions, recycling is the worst possible option.… Composting food wastes and recycling newspapers are the last thing we should want to do: Both interrupt the return of carbon to the Earth.

—Peter Huber, *Hard Green*, pp. 114–15

IV. POLICY IMPLICATIONS

Despite the importance of energy in our daily lives and the media attention that energy and environmental issues generate, the survey results show that Americans are often misinformed about basic energy issues. We are not running out of energy. Our "dependence" on foreign energy is not the Achilles' heel that many would have us believe. The oft-criticized "waste" of power involved in energy production is inherent in the physics of energy systems. Nuclear power does not have a deadly history in this country.

Why don't we know more about energy? Perhaps because, for the most part, we've rarely had to worry about it. As United States secretary of energy Samuel Bodman remarked in a 2005 speech to the Electric Power Association, "The energy we use is so constant, so dependable, so reliable, and—in relative terms—so affordable that consumers not only don't give it a second thought, they hardly give it a first one either."

Energy topics are not easy to contemplate. They can be highly technical and seem overly complicated. Moreover, energy and environmental issues treat a wide spectrum of somewhat unrelated topics, ranging from thermodynamics and agriculture to species protection and underground mining to foreign affairs and religion. Add to this the fact that in our advanced economy, the vast majority of consumption is hidden from view, and it's no wonder that the average consumer is ignorant of the details of energy production. Consumers have long assumed that flipping the switch means that the light goes on, but few stop to think about the energy economy beyond the wall socket that makes it all possible. Given the constancy and reliability alluded to by Secretary Bodman, there's little reason that they should.

Yet, whatever the reason for our ignorance, it is dangerous. The wide disconnect between what the public believes about energy issues and what is actually true has already moved our policies in unwise directions:

- We have failed to take needed steps to open energy-rich lands for exploration. For instance, we believe that oil exploration threatens Alaskan wildlife, and so we oppose efforts to find untapped reserves there.

- We think that our cities are more polluted than ever and that logging and development are shrinking our forests, and so we desire more onerous pollution controls and limits to what we term "sprawl."

- Our belief that America's oil use is inherently harmful has led us to adopt a number of failed policies. In 1980, the Carter administration set up the Synthetic Fuels Corporation to devise alternatives to crude oil. The program lost tens of billions of dollars with no success. Policymakers have also promoted ethanol as a substitute for gasoline, going so far in the 2005 Energy Policy Act as to mandate the use of 7.5 billion gallons of ethanol in the U.S. energy supply by 2012. This mandate comes on top of the several billion dollars in subsidies that the federal and state governments provide to ethanol R&D and production each year, subsidies that have done virtually nothing to increase ethanol's share in our energy mix.

- The belief that we are running out of oil, like the belief that we are addicted to oil, has pushed federal R&D efforts into a number of areas that have cost taxpayers vast sums of money but failed (as of yet) to yield any tangible results. The federal government has long invested in creating vehicles to run on fuels other than gasoline and vehicles far more efficient than current models. The Clinton administration started the Partnership for a New Generation of Vehicles (PNGV) to develop vehicles capable of getting 80 miles to the gallon. That program was replaced by the Bush administration's similar FreedomCAR program. President Bush also introduced a multibillion-dollar federal program to work with automakers and energy companies in developing hydrogen fuel cell technologies, with the idea of displacing the internal combustion engine. Meanwhile, the federal government has long mandated Corporate Average Fuel Economy standards for automotive vehicle fleets. Critics have noted that these standards have led automakers to produce lighter, less-crashworthy cars.

- Because our policy debate has failed to recognize that the vast majority of the oil that we consume comes from North America, we have overestimated the ability of nations such as Iran or Venezuela to use energy as an economic weapon against us.

- Because we are confident that renewable energy sources are the safest to produce and use, as well as the friendliest to the environment, many of us support further research and investment in those sources, while we shy away from increasing our investment in nuclear energy. Not a single new nuclear power plant has been ordered and licensed since the Three Mile Island accident in 1979, largely because of misplaced fears about "unsafe" nuclear power.

- The current bias that many Americans have against coal and the suspicions that many harbor about the expansion of nuclear energy threaten to keep millions of people in Third World nations impoverished as well as to prevent taking significant steps to deal with greenhouse gas emissions in the developing world.

- The belief that the twentieth century's uptick in temperatures is exclusively the product of mankind's use of fossil fuels has led us to take steps that would retard U.S. economic growth while doing little or nothing to deal with rising greenhouse gas emissions around the globe. The most prominent example, of course, was the Clinton administration's signing the Kyoto Protocol (which the Senate has never ratified; thus, the United States is not bound by the treaty's requirements). Many of us agree that the U.S. should sign the Kyoto Protocol on global climate change because we think that it would require all countries to cut their greenhouse gas emissions (which, as we have seen, is not true). Analyses of the treaty have concluded that it is unlikely to do anything significant to lower global temperatures. The cost, however, could be quite substantial. A 1998 assessment by the U.S. Energy Information Administration estimated that meeting Kyoto's targets "would cost the U.S. economy between $13 billion and $397 billion in 2010 (1992 dollars), or between 0.1 percent and 4.2 percent of average gross domestic product (GDP)."[42]

- Despite a consensus about skyrocketing future energy demand, we cling to the delusion that we can fully meet that demand through conservation and efficiency measures. The federal and state governments offer a host of conservation and efficiency programs and tax credits. The Energy Policy Act of 2005, in particular, contained a number of efficiency and conservation measures, including a provision lengthening daylight saving time. In addition, the law established tax breaks for purchase of hybrid vehicles and for the purchase and installation of energy-efficient appliances. The federal government for years has also promulgated efficiency-standard mandates for items such as dishwashers, clothes washers and driers, air conditioners, and even toilets. (A provision in the Energy Policy Act of 1992 mandated that toilets in new home construction must use 1.6 gallons of water per flush—or less than half the 3.5 gallons per flush of typical models.) Despite policymakers' emphasis on conservation and efficiency (in some cases, perhaps, because of it), Americans' total energy consumption is rising.

A clear understanding of how energy markets work is a prerequisite to enacting policies that will ensure continued economic growth and a healthy environment. With that in mind, our energy and environmental priorities should:

- Recognize that, in the future, we will need more energy supplies, not fewer. We should seek to maximize production of domestic sources of energy by removing the moratoriums on energy exploration in Alaska's Arctic National Wildlife Refuge (estimated more than 10 billion barrels of recoverable oil) and on the Outer Continental Shelf (estimated 76 billion barrels of technically recoverable oil).

- Encourage the renaissance for nuclear power in this country. Specifically, Congress must pass the legislative fixes to remove the roadblocks to completion of the Yucca Mountain nuclear waste depository. (The Department of Energy, for its part, must submit the license application for opening Yucca Mountain that it has promised since Congress approved moving forward with Yucca Mountain in 2002.) Moreover, Congress should ensure that the Nuclear Regulatory Commission has the funding, staff, and resources to process applications to build new nuclear plants in a reasonable and timely manner. Finally, the federal government should fully fund the Global Nuclear Energy Partnership and lift the ban on spent fuel reprocessing instituted by President Carter in 1977.

- Remove the special treatment that the federal government presently showers on ethanol. In particular, Congress should repeal the mandate to raise to 7.5 billion gallons the share of ethanol and other biofuels in our fuel mix by 2012. It should eliminate the 51-cent-per-gallon tax credit for domestic ethanol production and should eliminate the 54-cent-per-gallon tariff on ethanol that can be produced much more cheaply abroad.

- Continue to pursue research into cleaner coal-based power generation and gasification technologies, including the $1 billion FutureGEN coal-fueled prototype plant that will coproduce electricity and hydrogen while preventing air pollutants and greenhouse gas emissions. Furthermore, policymakers should instruct the national laboratories to fully investigate the promise of carbon sequestration.

- Continue research into long-shot but potentially revolutionary energy technologies such as nuclear fusion (through the international ITER consortium) and hydrogen fuel cells for automotive systems (through the International Partnership for a Hydrogen Economy).

- Continue basic federal research and development into hybrid vehicles, particularly in the areas of advanced battery technologies. Improved batteries will be the lynchpins for plug-in hybrids, bridging the gap between the automotive sector and electric power plants.

- Pursue advancements in renewable energy technologies such as wind and solar power. However, policymakers must keep in mind that these technologies will continue to produce just a small fraction of the energy that a growing economy requires. They can help meet our growing demand for energy around the margins but are unlikely to be able to replace more economical fuel sources and technologies such as coal, natural gas, oil, and nuclear power. Consequently, policymakers at the federal and state levels should resist calls to implement renewable portfolio standards that would only serve to drive up prices for consumers and provide less reliable supplies of energy.

- Eliminate regulations that hinder boosting refinery capacity. A morass of Clean Air Act and New Source Review regulations makes refinery expansion costly and effectively prohibits construction of new refineries. No new refineries have been built in decades, and the nation's inadequate refining capacity has contributed to driving up the price of gasoline. Federal policymakers must expedite existing refinery regulatory processes and approvals to ensure that consumers have adequate supplies of gasoline.
- Seek to permit the importation of liquefied natural gas (LNG) by authorizing construc-

tion of receiving terminals. Congress took steps in the right direction by including provisions in the 2005 Energy Policy Act that gave the federal government ultimate siting authority for new terminals. The Federal Energy Regulatory Commission must ensure that it exercises a leadership role that allows for the permitting and construction of onshore LNG terminals in a manner consistent with public safety.

- Be wary of taking extreme steps to deal with global warming based on an incomplete understanding of the role of humans in affecting climate change. Specifically, legislators and regulators should closely study the hard science contained in the reports issued by the Intergovernmental Panel on Climate Change (IPCC), while eschewing the "Summaries for Policymakers" issued months in advance of the full IPCC reports. The summaries for IPCC reports are written by a small group of political representatives from a number of member countries, and in the past they have been known to exaggerate or fabricate claims and to contradict the data provided by more than 2,000 scientists involved in the full IPCC process.

Finally, our energy and environmental policies must center on the best proven mechanism for finding solutions to our future challenges. The process of moving beyond a petroleum-based economy is happening not because of government targets or imperial dictates but because that is the direction that free markets appear to be leading us. Market forces are spurring the electrification of the economy. Whereas several generations ago, we relied on petroleum for much of our electricity, today we depend on nuclear power and natural gas for that share, an evolution shaped by economic realities. Whereas today our transportation sector relies almost exclusively on oil, tomorrow we can expect to depend to a much larger degree on electricity and, by extension, coal, uranium, natural gas, and renewable energy.

For those interested in further and more detailed research, Mark Mills and Peter Huber's book *The Bottomless Well* explains many of the ideas put forth here. Other ideas are explored in greater depth in articles by Manhattan Institute scholars and can be accessed at www.manhattan-institute.org/html/ce.htm.

APPENDIX SURVEY METHODOLOGY

This is a nationwide telephone survey of adults conducted by Zogby International. The target sample is 1,215 interviews with approximately 47 questions asked. Samples are randomly drawn from telephone CDs of national listed sample. Zogby International surveys employ sampling strategies in which selection probabilities are proportional to population size within area codes and exchanges. Up to six calls are made to reach a sampled phone number. Cooperation rates are calculated using one of AAPOR's approved methodologies[1] and are comparable to other professional public-opinion surveys conducted using similar sampling strategies.[2] Weighting by region, party, age, race, religion, and gender is used to adjust for non-response. The margin of error is +/- 2.9 percentage points. Margins of error are higher in sub-groups.

Zogby International's sampling and weighting procedures also have been validated through its political polling: more than 95% of the firm's polls have come within 1% of actual election-day outcomes.

The full polll results, including narrative analysis, may be downloaded on line at
http://www.manhattan-institute.org/energymyths/poll.pdf

[1] See COOP4 (p.38) in Standard Definitions: Final Dispositions of Case Codes and Outcome Rates of Surveys. The American Association for Public Opinion Research, (2000).

[2] Cooperation Tracking Study: April 2003 Update, Jane M. Sheppard and Shelly Haas. The Council for Marketing & Opinion Research (CMOR). Cincinnati, Ohio (2003).

Notes

[1] In a 2002 interview, Campbell said that "war, starvation, economic recession, [and] possibly even the extinction of homo sapiens" were the likely effects of hitting the down slope in world oil production.

[2] Peter W. Huber and Mark P. Mills, The Bottomless Well (New York: Basic Books, 2005), p. 18.

[3] Ibid.

[4] Figures from U.S. Energy Information Administration, Electric Power Annual 2005.

[5] U.S. Energy Information Administration, Annual Energy Review 2005, diagram 1, "Energy Flow," p. 3.

[6] Huber and Mills, The Bottomless Well, p. 23.

[7] Ronald Bailey, "Peak Oil Panic: Is the Planet Running Out of Gas? If It Is, What Should the Bush Administration Do about It?," Reason, May 2006.

[8] U.S. Energy Information Administration, California Crude Oil Production,
at http://tonto.eia.doe.gov/dnav/pet/hist/mcrfpca1a.htm.

[9] Speech to the sixteenth Annual Energy Efficiency Forum in Washington, D.C.

[10] "Chernobyl's Legacy: Health, Environmental and Socio-Economic Impacts and Recommendations to the Governments of Belarus, the Russian Federation and Ukraine," International Atomic Energy Agency, April 2006. The report was compiled by the Chernobyl Forum, a grouping of various UN agencies, other international organizations, and foreign governments looking into aspects of Chernobyl, at http://www.iaea.org/Publications/Booklets/Chernobyl/chernobyl.pdf.

[11] Gregg Easterbrook, The Progress Paradox: How Life Gets Better While People Feel Worse (New York: Random House, 2004), p. 42.

[12] Jesse H. Ausubel, "On Sparing Farmland and Spreading Forest," address prepared for September 2001 Denver convention of the Society of American Foresters (not delivered because of 9/11 but subsequently published).

[14] W. Brad Smith et al., Forest Resources of the United States, 2002, U.S. Department of Agriculture, Forest Service, p. 1.

[15] U.S. Department of Agriculture, Forest Service; Forest Inventory and Analysis, "Trend Data,"
at http://fia.fs.fed.us/slides/major-trends.ppt.

[16] Peter Huber, Hard Green: Saving the Environment from the Environmentalists (New York: Basic Books, 1999), p. 101.

[17] United Nations Food and Agriculture Organization, Global Forest Resources Assessment 2005, p. 21.

[18] U.S. Environmental Protection Agency, "Recent Climate Change,"
at http://www.epa.gov/climatechange/science/recentcc.html.

[19] United Nations Intergovernmental Panel on Climate Change, "Climate Change 2001: The Scientific Basis," p. 101.

[20] George C. Marshall Institute, "A Guide to Global Warming: Questions and Answers on Climate Change," January 15, 2000, at http://www.marshall.org/article.php?id=67.

[21] Robert L. Bradley, Jr. and Richard W. Fulmer, Energy: The Master Resource (Dubuque, Ia.: Kendall/Hunt, 2004), p. 142.

[22] Richard Gray, "UN Downgrades Man's Impact on the Climate," Sunday Telegraph (U.K.), December 13, 2006.

[23] The Kyoto Protocol to the United Nations Framework Convention on Climate Change.

[24] Keith Bradsher, "China to Pass U.S. in 2009 in Emissions," New York Times, November 7, 2006, at http://www.nytimes.com/2006/11/07/business/worldbusiness/07pollute.html?_r=1&adxnnl=1&oref=slogin&adxnnlx=1163097411-4GJ17MNFqKZS1CLUZb28tg.

[25] Ibid.

[26] The U.S. economy uses about 7 billion barrels of oil each year and the equivalent of 11 billion barrels in the form of other sources.

[27] U.S. Department of Energy, "Clean Coal Technology & the President's Clean Coal Power Initiative," at http://www.fossil.energy.gov/programs/powersystems/cleancoal/index.html.

[28] Clean and Safe Energy Coalition, at http://www.cleansafeenergy.org/WhyNuclear/TheBasics/tabid/66/Default.aspx.

[29] U.S. House Committee on Resources, "Top Ten Facts and Figures about ANWR."

[30] Energy Secretary Spencer Abraham, remarks to the 50 Club of Cleveland, May 5, 2003.

[31] Consumer Reports, October 2006, at http://www.consumerreports.org/cro/cars/new-cars/ethanol-10-06/overview/1006_ethanol_ov1_1.htm?view=Print.

[32] U.S. Energy Information Administration, "Potential Supply Impacts of Removal of 1-Pound RVP Waiver," September 2002, at http://www.eia.doe.gov/oiaf/servicerpt/fuel/rvp.html.

[33] Robert L. Bradley, Jr., "Renewable Energy: Not Cheap, Not 'Green,' " Cato Institute, August 27, 1997.

[34] Although it should be noted that much of the land could be used for other uses simultaneously.

[35] American Wind Energy Association, "Wind Web Tutorial," at http://www.awea.org/faq/wwt_environment.html.

[36] U.S. Department of Energy's Renewable Energy Technology Characterizations, 1997.

[37] U.S. Energy Information Administration, Annual Energy Outlook 2006.

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[39] Union of Concerned Scientists, "Global Warming 101: Human Fingerprints," at http://www.ucsusa.org/global_warming/science/Fingerprints.html.

[40] U.S. Environmental Protection Agency, "Climate Change: Science," at http://www.epa.gov/climatechange/science/pastcc.html.

[41] Huber, Hard Green, p. xviii.

[42] http://www.eia.doe.gov/emeu/plugs/plkyoto.html.