A New Energy Future

Options For A Smarter, Cleaner Energy Future

The State PIRGs' Campaign For A
New Energy Future

A U.S.PIRG Education Fund Policy Paper

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Options For A Smarter, Cleaner Energy Future

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Executive Summary

Modern life relies on energy. Energy gets us from place to place, enables us to live in otherwise inhospitable climates, and lights our lives. Had we failed to invent the light bulb, the combustion engine, or the refrigerator, our lives would be immeasurably different — and shockingly limited.

Because our dependence on energy is so absolute, we require a reliable energy supply at stable prices. We should be able to use energy when we need it, and pay a reasonable, predictable amount for it.

Further, the tradeoffs we make for energy should be sensible; that is, they should not create massive costs in other realms of the economy or our lives.

Recent fluctuations in supply, price, and policy have brought us to a crossroads for our energy future. We have a choice between the energy plan being proposed by President Bush, which would increase our reliance on dirty, unsustainable fossil fuels and nuclear fission and ultimately increase our nation's dependence on unstable foreign sources, or an entirely different path to a new energy future. That new energy future should be characterized by energy efficiency, reliance on clean, unlimited, and universally accessible energy sources, and a commitment to end the unacceptable tradeoff of our health and environmental quality for fossil fuel.

The Bush energy plan promotes and accelerates investment in the same sources of energy we have relied on throughout the last half-century — fossil fuels and uranium — as well as in the infrastructure that converts those fuels into power we can use. The plan proposes 1,300 new power plants (more than one per week for the next 20 years), 38,000 miles of new gas pipelines (ten times the distance from Maine to California), expanded fuel exploration and production to keep these plants operating, and dramatically increased air pollution from utilities.

The problems with the Bush energy plan break down into the following major areas:

Escalating environmental tradeoffs

The extraction of fossil fuels is a messy business that we have been willing to accept in return for the payoff of relatively cheap energy. But we are fast approaching the point at which the tradeoff is no longer tolerable. The oil, gas, and coal industries argue that the resources they provide are essentially unlimited: go ahead, use it up, we'll get more. What they fail to explain is that they will soon only be able to get more by exploring in locations that have long been held sacrosanct, off-limits to the destructive processes of drilling and mining due to their intrinsic beauty and environmental value. The fact that the Bush energy plan calls for drilling in the Arctic National Wildlife Refuge, Florida's Gulf Coast, the Rocky Mountains, and more underscores the unsustainability of our current energy path. Today these places, tomorrow… where? We simply can't afford to assault these significant pieces of our national heritage for oil that will last us only a few years – especially when better alternatives are available.

Further, the burning of fossil fuels is the chief cause of the global warming that is causing worldwide climate change. The tradeoff for continuing down the old energy path will be increased temperatures and massive weather changes that will be devastating to the economy and our lives.

Nuclear power is another environmental nightmare. Irradiated nuclear fuel, arguably the most dangerous substance known, is piling up in temporary storage facilities all around the country with no sound method for handling the waste. There is no good solution to this problem, and there may never be. This waste remains dangerous to humans and other living things for at least a quarter of a million years. Five metric tons of high-level radioactive waste is generated every day, with more than 34,000 tons already in temporary storage at the power plants. The mining and enrichment of uranium itself generates tons of waste which threatens nearby waterways.

Public health costs

Half the country lives in places where air quality exceeds basic health standards. In 1999, the health standard for smog was exceeded 7,694 times in 41 states, and fossil fuel power plants are the number one culprit. In the U.S., energy production and use is the cause of 95% of smog, 92% of fine particulate matter, and 34% of mercury emissions. These hazards lead to asthma, bronchitis, emphysema, and other respiratory ailments, as well as cancer and under-development of the brain and nervous system. We also experience these problems in our economy as excessive health care costs and lost productivity. Deepening our reliance on fossil fuels would exacerbate this public health crisis.

Energy production and use is the primary source of:

Global Climate Change	82%
Acid Rain	85%
Smog	95%
Nuclear Waste	95%
Oil Spills	100%

Wasteful spending on outmoded technology

Most experts agree that our days of reliance on fossil fuel and nuclear power are numbered because we are in the process of developing clean and sustainable sources, including wind power, solar photovoltaics, and the hydrogen fuel cell. It simply makes no sense to make a massive investment in old-fashioned energy when a worldwide conversion is likely inevitable. Were we to pour equivalent resources into clean alternatives today instead of investing in the Bush energy plan, our clean energy future would be much quicker to arrive. Instead, we're being asked to pour money into outmoded power plants, pipelines, vehicles, and other infrastructure that may not even serve its useful lifetime.

An increasingly unreliable future

By boosting our reliance on fossil fuels and largely dismissing energy efficiency and renewable energy, the Bush energy plan would ultimately force increased dependence on foreign oil by increasing our overall oil dependence. To date, we've used up 63% of the total historical and projected crude oil reserves in the U.S., while other countries still have 80% of their total stock left. While increased domestic oil exploration and recovery might cause a short-term reduction in imports as a percentage of consumption, it would only exacerbate the problem later. The only long-term means to reduce our dependence on foreign oil is to reduce our dependence on oil altogether.

For our electricity needs, energy companies are pointing to natural gas as the principal answer, but this leaves electricity markets vulnerable to uncertain natural gas flows and annual fluctuations in supply. Recent brownouts in California and price spikes around the country are partly the result of reductions in the available supply of natural gas.

Lack of consumer protection

The Bush energy plan favors large companies focused on traditional energy production and fails to promote opportunities for more nimble entrepreneurs to develop new technologies. The large traditional companies wield enormous power over the market with little democratic oversight. In addition, electricity deregulation has left consumers vulnerable to fluctuating energy prices. Consumers in some states have already seen prices rise dramatically due to skyrocketing wholesale prices set by companies that are reaping record profits.

A Smarter, Cleaner Energy Future

The alternative to the Bush energy plan is an immediate investment in a smarter, cleaner energy future. Strong support for energy conservation and efficiency, coupled with increased emphasis on the development of renewable energy, will produce solutions to the immediate energy crisis, make the energy supply more diverse and reliable, and move us along the path of a clean, healthy, and reliable energy future.

Conservation and Efficiency

Energy conservation and efficiency measures should always be our first response to potential supply/demand imbalances. They have the same effect as increasing supply without the negative consequences of increased energy production and use.

In most cases, efficiency measures that reduce demand are also cheaper and faster to implement than supply-side options. The California Public Utility Commission recently calculated that energy efficiency programs in that state have cost an average of 1.6 ¢/kWh, about a third of the typical cost of new fossil fuel power plants. And whereas large gas-fired power plants take 2–5 years to get online, savings from conservation measures can be realized in days or months. These savings can last as long as or longer than new power plants in the case of durable equipment and buildings.

There are great opportunities for energy conservation and energy efficiency improvements in each of the main sectors of energy use — transportation, industrial processes, and buildings & appliances. Vehicle manufacturers have made great strides in fuel economy technology, yet have not used these technologies to sell more efficient cars. Industry is slowly integrating whole system design into their factories and using more efficient motors and pumps. Building codes and appliance standards have the potential to greatly reduce energy consumption in commercial and residential buildings.

Renewable Energy

Renewable energy production has moved from its infancy to a significant source of power with the potential to grow exponentially in the next few years and beyond. After decades of developing the technology and identifying the resources, we can put this knowledge into action and significantly change the energy mix.

The best wind, solar thermal, and geothermal projects can now produce electricity for the same cost as fossil fuel electricity production. Many other projects could be developed at costs in the range of 5 1/2¢/kWh. This is close enough to the roughly 4 1/2¢/kWh cost of generation from coal and natural gas that it is worth our while to develop these resources now. The benefits will be felt throughout our economy in lower health care costs resulting from air pollution from power plants and less environmental damage from fossil fuel extraction and polluted air and water. Plus, generation costs will continue to decrease through economies of scale as new technologies become more widespread. Renewable energy production also creates well-paying, technology-oriented jobs.

For all of these reasons, stimulating renewable energy production is a more sensible long-term investment than propping up traditional energy systems. Most energy companies are reluctant to develop renewable energy projects even at equal cost to traditional fuels because of the inevitable uncertainties of new technology. But while they are less proven, renewables will be more beneficial and should be given higher priority.

Through a combination of requiring electricity retailers to buy power from renewable energy producers and providing financial incentives to narrow the cost difference, we could capitalize on a wealth of renewable energy opportunities. The federal government should require that electricity retailers buy at least 20% of their supplies from renewable energy producers by 2020 and should stimulate production through R&D subsidies and government procurement policies.

The nation needs to make a policy choice this year that will determine our energy structure for the coming years and decades. One path includes increased subsidies to fossil fuel and nuclear power companies, weakened clean air protections, extending the lifetimes of nuclear plants, and drilling in many sensitive areas throughout the country. The other path starts now with our transition to smarter, cleaner energy sources by encouraging renewable energy development and committing ourselves to energy conservation and efficiency. As this second path would reduce damage to our health and the environment and would save us money in the long run, it would be irresponsible to ignore this opportunity and drive the country further into fossil fuel dependence and nuclear risk.

Problems with the Current Energy Structure

The United States' exorbitant appetite for energy and stubborn reliance on polluting energy sources has created a damaging and instable energy structure. With more than 89% of all energy produced in the United States coming from coal, oil, natural gas, or nuclear, our present energy system threatens our health and the environment.[1] By relying on a few giant companies for our energy with minimal democratic oversight, the current structure also fails to protect consumers from market price fluctuations and manipulation. Continuing on this path would be financially wasteful, cause public health and environmental costs to escalate, and increase price and supply instabilities.

Public health damage

The health effects of energy production and use are not abstract or theoretical. They are very real and measurable. Energy-related pollution results in children with asthma, youths with diminished attention capacity, adults with chronic bronchitis, and lethal respiratory complications. We should fully recognize these problems as trade-offs for our current energy mix.

Approximately half the country lives in places where the air does not meet basic health standards.[2] Although the past thirty years have produced significant legislation to reduce harmful emissions from power plants and automobiles, our continued reliance on petroleum products and coal has offset any advances made as the population continues to grow.

Although coal plants make up only 56% of power plant boilers in the country, they are responsible for 93% of the industry's nitrogen oxide emissions, 96% of the industry's sulfur dioxide emissions, and 99% of the industry's mercury emissions.[3] These emissions are in turn the greatest contributors to smog, fine particulate matter, and atmospheric mercury deposition.

In addition, we are accumulating five metric tons of nuclear waste every day, arguably the most dangerous substance on the planet. With nowhere safe to put it, this waste will plague future generations.

Smog

Ground-level ozone, commonly known as smog, is our nation's most prevalent air contaminant. The American Lung Association estimates that more than 141 million Americans live in places where the air is unsafe to breathe due to smog.[4] During 1999, the health standard for ground-level ozone was exceeded 7,694 times in 41 different states and the District of Columbia.[5]

Chemically identical to the atmospheric ozone that protects us from the sun's harmful radiation, ground-level ozone is a colorless, odorless gas. It forms when nitrogen oxides (NOx) mix with volatile organic compounds (VOCs) in the presence of sunlight. Ground-level ozone is most common in the summer months, when the sun is the strongest, and in urban areas where both NOx and VOCs are most prevalent. Energy production and consumption in the United States emits more than 23 million tons of nitrogen oxides into the air each year.[6] Fuel combustion associated with transportation is responsible for over 53% of NOx emissions, and power plants make up another 27%.[7]

Inhaling ground-level ozone can be extremely dangerous. The ozone gas inflames and burns through sensitive lung tissue. The swelling and associated scarring decreases oxygen intake and can lead to asthma, bronchitis, emphysema, increased susceptibility to bacterial infection, and other respiratory problems. High concentrations of ozone can restrict the activity of even the healthiest individual. For at-risk populations, including children, the elderly, outdoor workers, and people with respiratory problems, ground-level ozone poses an immediate and severe health threat. Ozone pollution in the Eastern U.S. contributes to more than six million asthma attacks and 159,000 respiratory emergency room visits each year. [8]

Fine Particulate Matter

Sulfur dioxide (SO_2), another byproduct of energy production and use, is the primary component of fine particulate matter, or "soot." Health consequences of inhaling fine particulate matter include asthma, cancer, bronchitis, and other respiratory diseases, and can cause premature death. As with ozone, the inhalation of fine particulate matter disproportionably affects children, the elderly, and those with respiratory problems. The U.S. EPA estimates that fine particle pollution from U.S. power plants cuts short the lives of over 30,000 people each year.[9]

Particulate matter consists of tiny, visible particles of dust, ash, soot, and acid aerosols. Sulfates, formed from SO_2 emissions, make up the vast majority of fine particulate matter. More than 18 million tons of SO_2 is emitted to the air in the United States annually, 92% of which comes from fuel combustion.[10]

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Mercury

Power plants are responsible for 34% of mercury emissions from all known sources.[12] Power plants remain the only major unregulated source of mercury air pollution. Mercury is now so prevalent in our environment that fish in water bodies in forty states are unsafe for human consumption.[13]

Mercury is emitted into the air, undergoes photochemical oxidization and forms oxidized mercury. Oxidized mercury is deposited to land, lakes, rivers, and streams by precipitation, where it reacts with bacteria to form methyl mercury, the form most toxic to humans. Methyl mercury bioaccumulates in the tissue of fish and other aquatic animals and persists in the environment, magnifying its public health impacts. An expert panel on mercury atmospheric processes recently concluded that if all mercury releases were stopped today, it could still take more than fifty years for methyl mercury levels in fish to return to pre-industrial levels.[14]

Even at low levels, mercury can cause serious neurological damage to developing fetuses, infants, and children.[15] The neurotoxic effects of low-level mercury poisoning are similar to the effects of lead toxicity in children. These impacts include delayed development and deficits in cognition, language, motor function, attention, and memory. People at highest risk include women of childbearing age, pregnant women and their fetuses, nursing mothers and infants, and subsistence fishers. People who consume fish several times a week are more likely to be exposed to higher levels of mercury.[16]

Legislation has been pending in Congress since 1999 that would regulate the four main pollutants from power plants — nitrogen oxides, sulfur dioxide, mercury, and carbon dioxide. Any national energy plan should include a strategy for achieving dramatic reductions in these pollutants.

Nuclear Byproducts

The dangers of nuclear power and its related processes — from the mining of uranium, the enrichment process, the fission process, and the transportation and storage of nuclear waste — are difficult to quantify. Aside from the obvious risk of reactor meltdown and explosion, as happened in Chernobyl in 1986, the nuclear industry lacks a proven system for safely storing irradiated nuclear fuel rods, the most radioactive materials on earth and the most toxic substance ever produced by mankind.

Presently there are 34,400 metric tons of spent fuel in temporary storage in the U.S., with that number increasing by five metric tons every day.[17] The potential risk to human health is staggering. The exposure limit set by federal regulation for an individual is 5 rem per year; one curie generates a radiation field intensity at a distance of one foot of about 11 rem per hour. The total radioactivity of our spent fuel at this point is 30.6 billion curies.[18]

The risks of both catastrophic events and leakage of radioactive material into our environment pose great threats to our public health. Even low-level radiation has been linked to cancer, genetic and chromosomal instabilities, developmental deficiencies in the fetus, hereditary disease, accelerated aging, and loss of immune response competence.

Environmental harm

Fossil fuel combustion and nuclear fission are wreaking havoc on our environment. The most severe threats resulting from the combustion of fossil fuels are the potentially catastrophic effects of climate change. In addition, oil spills and runoff pollution continually impair our waterways, acid rain threatens forests and aquatic habitat, nitrogen overload is damaging estuaries and coastal waters, and the risk of radiation leaks endangers ecosystems.

Climate Change

Possibly the most dangerous effect of our current energy system is the alteration of our global climate. Carbon emissions from the burning of fossil fuels are the leading cause of climate change.

Since the advent of fossil fuel technology, we have doubled the concentration of CO_2 in the atmosphere. CO_2 is the most prevalent of the greenhouse gasses, which trap the sun's radiation in the earth's atmosphere and warm the surface of the earth. The latest report on the expected impacts of climate change released by the United Nations Intergovernmental Panel on Climate Change (IPCC) predicts that the temperature of the earth's surface will rise between 3 and 10.4 degrees in the next 100 years. The IPCC has already said: "Most of the observed warming in the last 100 years is likely to have been due to increases in greenhouse gas concentrations."[19]

The effects of such warming of the earth's surface are potentially catastrophic. The IPCC's latest report released in February 2001 states that large scale and irreversible climate change could alter ocean currents, cause devastating droughts, floods, and violent storms, and spread tropical diseases to temperate climates. In 2000 alone, extreme weather caused 222 deaths and $8.4 billion dollars in damage in the U.S.[20]

Acid Rain

In addition to producing ground level ozone and fine particulate matter, sulfur dioxide and nitrogen oxides are the largest sources of acid rain. Acid rain is directly related to the decline of entire forest and aquatic ecosystems throughout the East from Virginia to southeastern Canada.

Acid rain is mainly the result of the oxidization of sulfur dioxides and nitrogen oxides in the atmosphere, which then bond with hydrogen atoms and form sulfuric and nitric acid, respectively, and fall to earth. Acid rain and fog are extremely damaging to both forest and aquatic ecosystems. Acid rain damages the needles and foliage of trees, leaving them vulnerable to the elements, and depletes necessary nutrients from the soil in which trees grow. Acid fog has the same effects, although it tends to be more acidic than rain, and more damaging to the coastal and high elevation areas where fog is common.[21]

Aquatic ecosystems also suffer immensely from acid rain. There is a direct correlation between the increase in acidity of a water body and the decline in the number of species that can live therein.

Virginia's rate of acid deposition is among the highest in the nation. Due to acid deposition, half of the state's native brook trout streams have decreased abilities to host trout populations, and 6% are completely unable to support fish populations.[22]

Oil Spills

In addition to the environmental consequences of burning fossil fuels, extracting and transporting fossil fuels is highly destructive as well. The U.S. consumes 818 million gallons of oil and petroleum products daily,[23] 31,000 gallons of which spill into U.S. waterways every day.[24]

The U.S. currently uses 231 billion gallons of crude oil each year. To meet this demand, we produce 94 billion gallons of crude oil domestically and import 137 billion gallons.[25] At every point in the oil production, distribution, and consumption process, oil is inevitably stored in storage tanks that are vulnerable to spills and leaks. With billions of gallons of oil stored throughout the country, oil spills are a regular occurrence.

Between 1973 and 1993 there were 200,000 oil spills in U.S. waters, spilling more than 230 million gallons of oil.[26] The impacts of these spills vary depending on the specific habitat affected and the chemical composition of the oil. The main risks of spills include the physical smothering of plant and animal life by oil residue and toxic tainting.

Nitrogen Loading

Another extremely damaging effect of the release of nitrogen oxides into the atmosphere from fossil fuel combustion processes is nitrogen loading of aquatic ecosystems.

Atmospheric nitrogen deposition from NOx emissions causes the overfertilization of water bodies. Algal blooms starve the water of oxygen as they die and decompose, killing all life in the area. Algal blooms also block much needed sunlight in aquatic ecosystems. Atmospheric deposition of nitrogen is threatening the health of the Chesapeake Bay, the Great Lakes, Lake Champlain and many other coastal bodies. Studies show that as much as 27% of the nitrogen that enters the Chesapeake Bay can be attributed to air pollution.[27] One of the most dramatic results of nitrogen loading is a 7,000 square mile "dead zone" in the Gulf of Mexico at the mouth of the Mississippi River.[28]

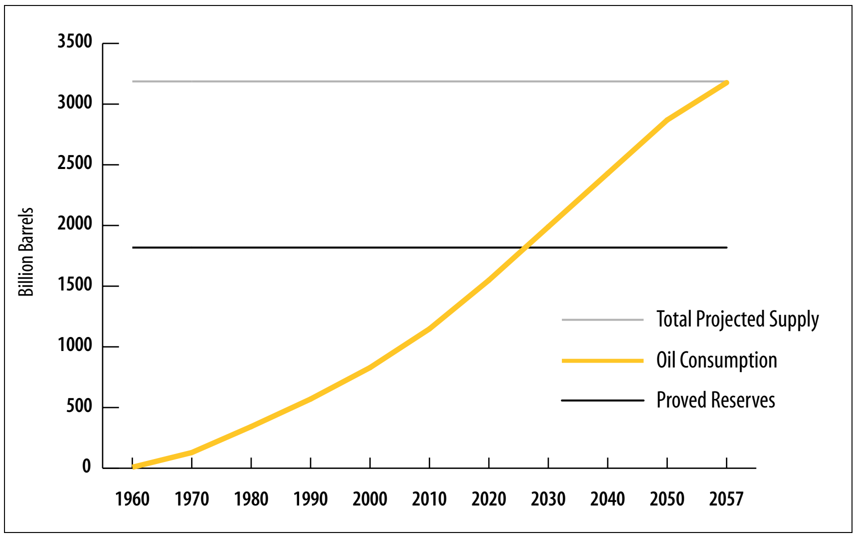
Coal Mining

Unregulated disposal practices from coal mining contaminate drinking water and land in the vicinity of mines. Toxins such as arsenic, mercury, chromium and cadmium are released into unlined ponds and landfills. These chemicals leach into the groundwater and contaminate drinking water.[29]

Coal mining, especially mountain top removal mining, harms local ecosystems. 15-25% of the mountains in southern West Virginia have been leveled with mountain top removal, burying 1,000 miles of streams in waste and eliminating 30,000 acres of hardwood forest. One mine can strip up to ten square miles and dump enough waste to fill twelve valley fills, each up to 1,000 feet wide and one mile long.[30]

Total Projected Oil Supply (billion barrels)[b]

Region	Past Production	Proved Reserves	Projected Discoveries	Total Reserves	Current Annual Use	Avg Annual Demand Growth
non-US	579	995	1,261	2,256	20	
US	222	22	108	130	7	1.3%
World	801	1,017	1,369	2,386	27	2.3%



Consequences of unsustainability

Fossil fuels are a limited resource. Clearly we cannot continue to rely on them forever. Some people fear that we will run out and have no place to go, while others feel that we will keep finding new deposits and do not need to worry about it. Both of these views miss the point. We should be concerned about the limited nature of fossil fuels because of escalating environmental costs and supply instabilities, and because deepening our dependence on them is a waste of money and effort. Unsustainable equates to wasteful, damaging, unreliable, and unstable.

Wasteful & Damaging

At projected levels of demand, the world has about 25 years worth of "proved oil reserves." After that, we will have to look harder for deposits. The U.S. Geological Survey estimates we could ultimately find enough new reserves worldwide for another 30 years or so if we do not cut demand, but it would come at higher environmental and social costs. The reason that future expected supply is not yet "proved" is that it is more difficult to get at. Even if the Arctic National Wildlife Refuge, the Florida coast, and protected public lands are kept off limits to drilling for now, ten years from now there may be even more pressure to drill in such places despite their value.

Natural gas is even more of a supply problem. Energy companies have responded to concerns about the health effects of burning coal by proposing that all future power plants be fueled by cleaner-burning natural gas. But domestic proved reserves will be spent by 2007, and expected future finds will only get us to 2032, according to demand projections by the U.S. Department of Energy.

This is not to suggest that we will burn our last drop of oil by 2057 or our last wisp of gas by 2032. It is a near certainty that we will reduce our use of oil and gas well before then. The point is that we are heading down a dead-end road with the end in sight and should not wait to change our energy infrastructure. If we continue to orient our society around fossil fuels, the trade-offs we endure to get our fuel out of the Earth will be increasingly painful, and we will be wasting a lot of money and effort.

Vice President Cheney recently stated that his energy plan would require 38,000 miles of new gas pipelines.[31] This would be a tremendous investment for a relatively short-term solution. Similarly, every investment in fossil fuel-based power plants, vehicles, furnaces, and other infrastructure is money poorly spent.

The Vice President also has called for the construction of more than one power plant per week for the next twenty years, with most of them fueled by natural gas. At an average lifetime of forty years, we would run out of domestic natural gas supplies before those plants are used for their full lifetimes. In recent years, "stranded costs" from bad investments in nuclear power plants have been an issue. Twenty-five years from now, we may face stranded costs from gas-fired power plants that are no longer economically viable due to limited resources.

Energy experts of all backgrounds agree that energy production will shift from fossil fuels to renewable technologies as the price of fossil fuels goes up and the price of renewables declines. But where do we put our efforts? By focusing on traditional fuels, we are raising the cost of fossil fuels by pushing them toward depletion rather than lowering the cost of renewables through R&D efforts.

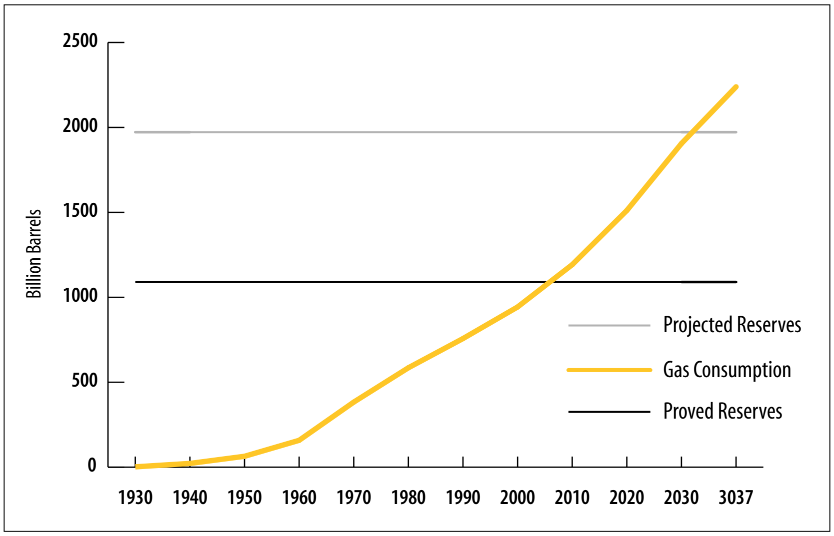
Unreliable & Unstable

One of the main points of context in debating a national energy policy is our dependence on foreign oil. The U.S. now

Total Projected Natural Gas Supply (trillion cubic feet)*

Proved Reserves	Projected Discoveries	Total Reserves	Current Annual Use	Avg Annual Demand Growth
167	882	1,049	22	2.3%

* Proved reserves: U.S. DOE, Energy Information Administration (EIA), International Energy Annual, 1999; projected discoveries: U.S. Geological Survey, *World Petroleum Assessment*, 2000; current use and annual growth: U.S. DOE, EIA, "World Natural Gas Consumption by Region," *International Energy Outlook*, 2001.



imports 57% of its crude oil.[32] Oil imports are responsible for half of the trade deficit. This is clearly not good for the U.S. economy.

While exploring for domestic supplies may seem like an obvious answer, this would actually increase our foreign oil dependence if it sustains our overall oil dependence. In the U.S., we only have 5% of the world's projected oil reserves. We have already used 63% of our total historical and projected future stock of crude oil, while all other countries combined still have 80% of their stock left. Aggressively pursuing domestic supplies may bring a dip in imports vs. domestic production, but this effect would certainly be short-lived. In fact, the sharper the dip now, the worse the problem will be in the future. The only real way to reduce our

Remaining Oil Reserves[c]

Region	Total Reserves	Past Production	Total Stock	Pct Used
non-US	2,256	579	2,835	20%
US	130	222	352	63%
World	2,386	801	3,187	25%

dependence on foreign oil is to reduce our dependence on oil overall.

Fossil fuel dependence also leads to price instabilities. The current California energy crisis has been driven partly by increases in the price of natural gas, which in turn has led to spikes in wholesale electricity prices. As the nation becomes more dependent on natural gas, this will be more problematic everywhere. Renewable energy producers, in contrast, are not subject to commodity price spikes. Their fuel is free.

Subsidizing fossil fuels will not help stabilize gas prices. According to the Congressional Research Service, "Crude oil prices have since the 1970s been determined in a world oil market, a market which has become more competitive and in which U.S. domestic producers are price takers. In such a market, the subsidies for oil and gas have little if any effect on the market price of crude oil."[33]

Time to Reorient

The choice is not whether to go down the sustainable path. The only choice is when. Do we push the dirty stuff and drag our feet on the clean stuff until oil and gas are nearing depletion, or do we start building the sustainable energy future now?

Consumer vulnerability

As outlined above, reliance on fossil fuels leaves consumers vulnerable to volatile oil and gas markets. Traditional energy sources also rely on large centralized production and distribution systems with minimal democratic oversight or local control.

Oil company mergers over the past five years have resulted in a vastly increased concentration of ownership of oil production and distribution. Just four companies now dominate the American market, wielding enormous power over the marketplace and exerting undue political influence. ExxonMobil reported profits of $15.9 billion last year, the highest ever by any corporation. Chevron's profits increased 150% from 1999, with a reported profit of more than $5 billion last year.

Deregulated electricity markets in 24 states also have left consumers vulnerable. Free of regulatory oversight, energy producers have played the market to their advantage, reaping record profits through billions of dollars in taxpayer money and increased rates.

- A recent Union of Concerned Scientists report found that power plant outages rose nearly 50% after the onset of deregulation in New England. These outages coincided with higher prices more than 76% of the time.
- According to the Boston Globe, the Justice Department is investigating price manipulation by PG&E and other utilities in Massachusetts.
- A recent Massachusetts study estimated that generators overcharged consumers last year by approximately $2.1 billion.
- The California deregulation plan included an estimated $20 billion in bailouts for expensive nuclear power plants and other costs, which the parent companies shifted to other subsidiaries. California's consumers were promised cheaper power, but are now facing rolling blackouts and skyrocketing electric bills.
- The state of California has charged that several companies, including

Reliant Energy, Dynegy, Williams/ AES, Duke Energy, and Mirant, manipulated the electricity market, including withholding electricity, to reap an excessive $5.5 billion for power from May 2000 through February 2001.

An industry dominated by a few giant players needs strong governmental oversight to make sure monopolies do not abuse the market. The Federal Trade Commission should give greater scrutiny to energy company mergers, and agencies overseeing energy systems should step in when abuses occur.

One of the greatest federal regulatory needs at the present time is a federal price cap on wholesale electricity sales. While free market theorists argue that energy companies need incentives to build new power plants, even these theorists should agree that hundreds of dollars per megawatt-hour is an excessive and counterproductive weight on the economy. Prices on the western wholesale market have frequently been ten times higher than equivalent prices over the past decade. This type of price-gouging indicates a failing market system, and the federal government should intervene to correct these market problems.

Conservation and Efficiency

When faced with potential supply shortfalls due to growing demand or aging generation facilities, conservation should always be studied before increasing supplies. Reducing demand has the same effect on the supply/demand balance as increasing supply, but without the negative impacts of energy production and use.

According to the Alliance to Save Energy, energy efficiency measures implemented since the 1970s have reduced our energy use by 40% from what it would have been. This has translated into energy bills at least 40% lower.

In most cases, demand management options are also cheaper and faster to implement than supply-side options. The California Public Utility Commission recently calculated that energy efficiency programs administered by the state's utilities from 1994–97 came at an average cost of 1.6 ¢/kWh, about a third of the typical cost of new fossil fuel power plants.[34] And while large gas-fired power plants take 2–5 years to get online, savings from conservation measures can be realized in months. These savings can last as long as or longer than new power plants in the case of durable equipment and buildings.

There are great opportunities for energy conservation and energy efficiency improvements in each of the main sectors of energy use — transportation, industrial processes, and buildings & appliances. Vehicle manufacturers have made great strides in fuel economy technology, yet have not brought many of these technologies to market. Industry is slowly integrating whole system design into their factories and using more efficient motors and pumps. Building codes and appliance standards have the potential to greatly reduce energy consumption in commercial and residential buildings.

Energy conservation and efficiency programs also benefit consumers more than supply-side options. After the initial expense of purchasing better appliances or installing better meters that allow them to use energy more wisely, consumers benefit from smaller utility or fuel bills. Research by the RAND Corporation has shown that energy efficiency improvements over the last 25 years have saved Californians billions of dollars — up to $1,300 per person — and gave the entire state economy a 3% boost.[35]

U.S. Energy Use by Sector[d]

Sector	Energy Use (quadrillion BTU)	Pct of Total
Transportation	25.92	27%
Industrial	36.50	38%
Commercial	14.14	15%
Residential Appliances	9.90	10%
Residential Heating	10.13	10%

Transportation

The two best approaches to improving efficiency in the transportation sector are through raising minimum miles-per-gallon standards and requiring manufacturers to produce minimum percentages of zero-emission and low-emission vehicles.

Fuel Efficiency Standards

In 1975, President Ford and a bipartisan vote in Congress enacted Corporate Average Fuel Economy (CAFE) standards. These standards required that the average fuel economy of all cars and trucks sold by each manufacturer meet specific targets. They are not requirements for individual vehicles or models, but rather a minimum for the average of all vehicles sold by each car company.

The standards quickly led to dramatic improvements in fuel efficiency, improvements that continue to benefit consumers today. Existing standards save the average new car owner $3,300 in expenditures for gasoline, and prevent hundreds of millions of tons of global warming pollution. This amounts to a savings of more than a billion barrels of oil each year.[36]

Congress set initial CAFE standards at 18 miles per gallon (mpg), and gave the Executive Branch the authority to update standards each year. Today, cars must achieve an average of 27.5 mpg, while light trucks (SUVs, pickups, minivans) must achieve an average of 20.7 mpg.

When CAFE standards were first passed, light trucks represented a small portion of new vehicle sales. Since then, however, carmakers have exploited the loophole allowing light trucks to pollute more by developing and marketing a whole new class of vehicles — the SUV for non-commercial use as a family car. Since requirements for the fuel efficiency of these vehicles are low, manufacturers have not prioritized fuel economy. Although they have the technology to make more efficient light trucks, car companies have not done so. Polling shows that most SUV drivers would prefer more efficient engines, but the automakers do not give them that option.

Closing this loophole by requiring light trucks to meet the same standards as cars would save owners of SUVs, minivans, and large pickups more than $27 billion per year in gasoline costs, easily paying for any costs in updating vehicle technology, and would reduce U.S. global warming emissions by 187 million tons.[37] In just over three years it would save as much gasoline as is economically recoverable from the Arctic National Wildlife Refuge.[38]

In 1994, Congress froze CAFE standards at their already outdated levels and prevented the DOT from even studying the appropriateness of updating the standards. Each year since then, the House has upheld these restrictions. In 2000, a bipartisan group of 40 senators reached a compromise that left the CAFE freeze in place but authorized a study by the National Academy of Sciences to determine the impacts of improving CAFE standards. Their recommendations are due by July 2001.

The auto industry, which has historically opposed increased standards, is beginning to talk about voluntarily increasing the fuel economy of their largest vehicles as gasoline prices start to rise. This shows that the technology exists, but such voluntary measures would not guarantee that the companies will maximize fuel economy.

The federal government should require that car companies make changes that are good for consumers, good for the environment, and good for long-term energy policy by closing the SUV loophole and raising CAFE standards for all vehicles.

Zero-Emission Vehicles

In 1990, the California Air Resources Board instituted the Zero Emission Vehicle (ZEV) Program, requiring the gradual introduction of ZEVs in California beginning in 1998. Specifically, 2% of light-duty cars and trucks (not including SUVs and large pickups) sold by the major car manufacturers in 1998 were to be ZEVs, followed by 5% in 2001 and 10% in 2003. Since then, the board has weakened these requirements three times. As the program currently stands, 2% of new car sales in 2003 must be ZEVs, another 2% must be low emission hybrids, and an additional 6% must be low emission gasoline-powered cars. These minimum requirements will gradually be ramped up in subsequent years.

Since California's 1990 action, three other states have started ZEV programs.

New York, Massachusetts, and Vermont have opted to make California's regulations their own, although it is unclear if these states will go along with California's recent modifications.

Effectively implementing this program would result in significant energy savings, thus making our overall transportation energy system more efficient. More important, however, is the effect the program will have in stimulating the development of new technology and its integration into the marketplace. In addition to electric vehicles, the use of which is slowly becoming more accepted in California, the ZEV Program has spurred the development of gas-electric hybrids and high-efficiency gasoline and compressed natural gas vehicles. The program also has led to the formation of the California Fuel Cell Partnership, a collaboration of major automakers and energy companies to push the commercialization of fuel cell technology. When such vehicles are the dominant form of transportation, we will have today's ZEV requirements to thank.

Buildings and appliances

Appliances

Previous appliance efficiency standards have saved consumers money – including initial purchase cost – while saving energy. The DOE estimates that existing appliance standards in 2000 saved 1.2 quads of energy (1.3% of total energy use) while reducing consumer energy bills by $9 billion.[39] Standards now being debated and implemented are also projected to be win-win solutions. Consumers will realize more than $3 in energy savings for every $1 in extra purchase cost over the life of appliances purchased after the new standards go into effect.[40]

The 1987 National Appliance Energy Conservation Act (NAECA) requires the periodic updating of appliance efficiency standards. In 1997, the DOE began to update the standards for fluorescent lights, clothes washers, water heaters, and central air conditioners and heat pumps. The fluorescent light bulb standard was completed in late 2000, and the other three were finalized in the final month of the Clinton administration. If properly implemented, appliance standards will save 4.2 quads per year (3.5% of projected total energy use) by 2020. Most importantly, much of this reduction would be at times of peak electricity demand, cutting peak demand by 12.6% and eliminating the need for 300 power plants.[41]

President Bush has announced his intention to weaken the standard for residential air conditioners and heat pumps. Since air conditioners operate at times of peak demand — and in fact directly lead to those peaks — this is the most important standard. The more we can reduce peak demand, the fewer power plants we will need to build. Despite the fact that this rule was more than three years in the making, the Bush administration has opened another round of rulemaking, with a final rule expected by October 2001.

The state PIRGs endorse the three policy recommendations recently developed by the American Council for an Energy-Efficient Economy.

- Maintain the residential air conditioner standard as finalized under the Clinton administration. Lowering the standard from a 30% improvement over the existing standard to 20%, as the Bush administration now proposes, would reduce peak electricity savings by 17,000 MW, creating the need for an additional forty power plants.[42]
- Develop strong standards for commercial air conditioning systems and residential heating systems. These standards are next in line according to NAECA, and rulemaking should proceed in a timely manner.

- Develop national standards for products not covered by NAECA, including commercial refrigerators, traffic lights, distribution transformers, ice makers, and many other products. Several states have developed or are developing such standards. Uniform national standards would benefit everybody.

These steps would cost-effectively result in a 1% reduction in total U.S. energy use, saving consumers $7 billion per year by 2020.[43]

Buildings

The Alliance to Save Energy, a coalition of prominent business, government, environmental, and consumer leaders, estimates that we could reduce electricity consumption by 30% with no reduction in current or future living standards using existing technology improvements. The Rocky Mountain Institute and the Worldwatch Institute estimate that improved building designs, in conjunction with market penetration by highly-efficient appliances, can cut total energy use in half. To achieve these savings, governments must implement policies including mandatory standards and financial incentives.

Utility programs

In addition to setting standards, the federal and state governments fund and mandate energy efficiency improvements, with most of the programs administered by electric utilities. These programs have included weatherization for low-income households, appliance recycling, efficiency programs for business customers, and more.

With utility deregulation, funding for utility energy efficiency programs has fallen dramatically. California offers an interesting case study of the effect this has had. Funding for gas and electric programs averaged $313 million from 1990-93. It then dropped to a low of $198 million in 1996 and an average of $226 million from 1994–98.[44]

The California Energy Commission recently estimated that the state lost more megawatts through cuts in energy efficiency programs than the amount of shortages that have sent the state into rolling blackouts on several occasions. If funding for energy efficiency programs had stayed as high from 1995–1999 as it was in 1994, savings from these programs would have reduced demand in 1999 by as much as 1,101 MW.[45] Most of the rolling blackouts this year have been caused by shortages of 500 MW.

These programs are cost-effective. The California Public Utility Commission recently calculated that energy efficiency programs administered by the state's utilities from 1994–97 came at an average cost of 1.6 ¢/kWh, about a third of the typical cost of new fossil fuel power plants.[46] The benefit cost ratios for utility energy efficiency programs are 1.09 for residential programs, 1.90 for non-residential programs, and 2.18 for new construction programs — a weighted average of 1.61. A benefit cost ratio greater than one indicates that a program's benefits are greater than its costs.[47]

Industry

The opportunities for industry to increase efficiency and therefore conserve energy are immense. Efficiency pioneer Amory Lovins at the Rocky Mountain Institute points out that since only 10% of industrial energy use actually goes into the ultimate manufactured products, overall energy efficiency in the U.S. could theoretically be increased by as much as 90%.[48] Efficiency experts have successfully encouraged the governments of Austria, the Netherlands, and Norway to commit to a 75% reduction in energy and material resource use, and similar plans have been endorsed by the European

Union.[49] In the U.S., largely due to a lack of will and the continued availability of cheap energy, industrial processes are extremely inefficient.

Short term gains in energy efficiency can be made through the upgrade of individual devices in the industrial process, including motors, chemical separations, lighting, and heating elements. Even more efficiency would result from the use of emerging technologies such as fuel cells, advanced turbine systems, and non-combustion gasification of biomass and non-plant residue.[50]

While improved components are important, increasing the efficiency of industrial processes will produce the biggest long-term gains. Process efficiency improvements include more selective catalysts, advanced separations, improved measurement and control systems, improved materials, and improved electric motor designs. Most importantly, the industrial process should be evaluated using a "systems thinking" approach, avoiding unintended consequences and incorporating energy flow considerations into every aspect of system design.[51]

Resource recovery, reusing materials, and recycling will be key final steps in maximizing industrial efficiency and minimizing waste, both in energy and other material aspects of the industrial process. Redesigning both the systems themselves, the components and technologies, and closing the loop in the relationship between manufacturers, producers, and consumers will allow for energy use to be optimized.

Pricing mechanisms

The difference between average daily electricity use and annual peak demand is often as high as 40%–50%. We need the generating capacity to meet annual peak demand, yet only use the full capacity in the relatively limited time periods when demand is at or near its annual peak. Any changes to shift electricity use from peak demand times to off-peak times would therefore reduce the amount of generating capacity needed. Even if the total amount of electricity were to remain constant, such changes would enable fewer power plants to provide that electricity.

The most effective way to take advantage of peak demand savings is with real-time pricing, making electricity more expensive during times of peak demand and cheaper at low demand times. "Smart meters" would track time-of-day electricity use and send price signals to consumers. Large commercial customers such as hotels and shopping centers, which already have computerized climate control systems, can simply program these systems according to their preferences. If these customers allowed temperature to rise and lights to dim just a bit during peak demand times, the collective energy savings would be substantial. As computer-driven central heating and cooling systems become more common in homes, smart meters may gain wider residential applications as well.

Another policy option which can shave peak demand is to encourage contracts between utilities and large electricity consumers that provide financial incentives for the customers to shut down their operations during peak demand times. Utilities have used such contracts, but with mixed responses from customers. The first generation of such contracts gave the customers a lower electricity rate at all times in exchange for an agreement to have their power shut off when power supplies were low, without any specification as to how often that might be. For several years the program worked successfully until the recent California supply shortages caused customers with these contracts to lose power much more often than expected, causing the customers to withdraw from the contracts. The newer generation of contracts makes power cutoffs voluntary, with separate financial incentives each time a customer agrees to go without power during peak demand.

Renewable Energy

The potential exists to move quickly into renewable energy production. The European Union has established a target of 12% of total energy supply, including transportation, from renewables by 2010.[52] A 1995 study by Shell Petroleum estimated that 50% of the world's energy could come from renewable sources by 2050.[53]

Decades of R&D efforts in renewable technologies are paying off. The best wind and geothermal projects can now produce electricity for less than the cost of fossil fuel electricity production. Many other opportunities are available in the range of 5 1/2 ¢/kWh. This is close enough to the roughly 4 1/2 ¢/kWh cost of generation from coal and gas that it is worth our while to develop these resources now. The benefits will be felt throughout our economy in lower health care costs resulting from air pollution from power plants and less environmental damage from fossil fuel extraction and polluted water. Plus, generation costs will come down through economies of scale as new technologies become more widespread.

The California Public Utilities Commission recently concluded that the state could get an even larger benefit from helping to fund renewable energy systems for small users than they get from energy efficiency programs, and the efficiency programs themselves are estimated to be only a third of the cost per kilowatt of generating power in large coal and gas plants.[54]

Renewable energy production also creates well-paying jobs and has ripple effects throughout the economy. In Iowa, farmers are turning a profit and helping to stabilize the state's energy supply by installing windmills in their fields. Farmers are making $2,000 per year profit for each turbine installed.

For all of these reasons, stimulating renewable energy production is a more sensible long-term investment than propping up traditional energy systems. Most energy companies are reluctant to develop renewable energy projects even at equal cost to traditional fuels because of the inevitable uncertainties of new technology. But while they are less proven, renewables will be more beneficial and should be given higher priority. Through a combination of requiring electricity retailers to buy power from renewable energy producers and financial incentives to narrow the cost difference, we could capitalize on a wealth of renewable energy opportunities.

The federal government should adopt a national "renewable portfolio standard," requiring at least 20% of our electricity to come from renewable sources in twenty years. As each of the four main clean renewable resources — photovoltaics, solar thermal, wind, and geothermal — show enough promise that we could expect to achieve as much as 10% of our electricity from each of them by 2020 given appropriate incentives, this is a cautious minimum.

Such a policy is obviously unlikely under the current administration, but industry and government analysts have concluded that it is possible. Were we willing to commit the same level of effort to implementing renewable energy technologies as the administration is proposing for the construction of more traditional power plants, wells, and pipelines, we would be able to satisfy our energy needs and move well along the path of energy sustainability at the same time.

Wind

Capacity

Implementation of wind power is still in its infancy, although recent growth has made it a significant source of electricity. Wind turbines in use as of 2000 had an average output of 891 MW.[55] Wind power grew by 24% annually throughout the 1990s. It is now a $4 billion industry worldwide.[56]

Wind Power Capacity by State (average MW)[e]

State	Capacity	State	Capacity
CA	581	HI	4
MN	91	PA	4
IA	86	NY	3
TX	63	VT	2
WY	30	NE	1
OR	8	KS	1
WI	8	TN	1
CO	7		

Potential

There is much untapped potential for wind power. The U.S. has enough windy spots to cost-effectively install the turbines to generate an average output of more than a million MW, according to the Pacific Northwest Laboratory (PNL), a public/private research arm of the U.S. Department of Energy. This is three times the amount of electricity the country used in 2000.[57]

The National Renewable Energy Laboratory, another public/private DOE lab, made more conservative estimates in 1994, measuring wind generating capability in locations with moderate land use and environmental restrictions within ten miles of existing transmission lines. They estimated that the U.S. could generate 734,000 MW of electricity from turbines in such locations — nearly twice as much as total current demand.[58]

The wind energy industry has been gearing up for growth. If major new policies are put in place to facilitate and encourage wind development, wind power

Future Wind Power Generation with 30% Annual Growth (average MW)[f]

Year	New installation	Total capacity	Projected Demand	Wind Share of Total Demand	Increase in Demand	New Demand Met by New Wind Installations
2000		891	391,667	0.2%		
2001	798	1,689	400,342	0.4%	8,676	9%
2002	1,037	2,726	409,361	0.7%	9,018	12%
2003	1,349	4,075	417,009	1.0%	7,648	18%
2004	1,753	5,828	425,685	1.4%	8,676	20%
2005	2,279	8,107	434,932	1.9%	9,247	25%
2006	2,963	11,070	443,950	2.5%	9,018	33%
2007	,852	14,922	453,767	3.3%	9,817	39%
2008	5,007	19,929	463,242	4.3%	9,475	53%
2009	6,510	26,439	472,032	5.6%	8,790	74%
2010	8,462	34,901	481,963	7.2%	9,932	85%

Region	Wind Potential: NREL Estimates	Wind Potential: PNL Estimates	1999 Use	Potential Pct of Use: NREL Estimates	Potential Pct of Use: PNL Estimates	Excess (Need): NREL Estimates	Excess (Need): PNL Estimates
Western States	145,361	324,840	66,830	218%	486%	78,531	258,010
Central States	565,812	763,920	102,633	551%	744%	463,179	661,287
Eastern States	22,921	30,247	203,932	11%	15%	(181,011)	(173,685)
Total	734,094	1,119,007	373,394	197%	300%	360,700	745,613

Regional Wind Potential (average MW)[g]

generators could deliver a significant portion of energy needs to the electric grid within the next decade. This year, the industry will install enough turbines to generate an average of 798 MW in the U.S.[59] If new installations were to increase by 30% each year thereafter — a rapid but feasible rate — the country could generate more than 7% of its electricity from wind power by 2010. This modest proposal would still only tap 35,000 MW of the 734,000 MW potential, but it would displace the need for 85 fossil fuel power plants.

Wind Power in Regional Markets

The Rocky Mountain and Plains states theoretically have enough wind resources to supply the entire country's electricity needs. Although transmission losses do not make it practical to generate 100% of the nation's energy from these states, we can increase production there without encountering barriers of transmission distance. With electricity supplies tight throughout the West, increases in energy production in the mountain states could easily ripple through the grid toward the coasts. States without enough domestic wind potential for their own power needs should use long-term contracts to encourage these states to generate wind power and export it into regional markets. (See appendix for wind potential figures for each state.)

Cost

The current price of wind power is 10% of its 1980 price. New wind plants are producing electricity at costs as low as 4¢/kWh, which is competitive with fossil fuels. Costs are projected to decline further still.[60]

Colorado offers a good example of a state that has officially declared that wind power is cost-effective and is now capitalizing on this opportunity. The Colorado Public Utilities Commission recently determined that new wind turbines would cost less than new natural gas power plants and ordered the state's major utility to build a large wind farm.

Photovoltaics

Capacity

Photovoltaic (PV) energy production, which converts light from the sun directly into electricity, is all around us, from satellites to road signs to watches to rooftops. All told, this is still a very small portion of our energy use, but growth has been steady and is expected to continue at an increasing rate. More than 10,000 U.S. homes are now powered entirely by solar energy, and current energy concerns have sparked more interest than ever in residential PV use.[61] The rate of installations of PV panels in the U.S. grew by an average of 23% per year from 1993–1999.

1999 U.S. PV Peak Capacity (MW)[h]

Sector	Capacity
Electric Utilities	5
Nonutilities	44
Dispersed	145
Total	**194**

U.S. companies have been world leaders in PV manufacturing and are well positioned to handle future domestic growth. PV manufacturing capacity doubled in the past five years and is expected to double again in the next three years.[62] Manufacturers have shipped 69% of panels overseas in recent years.

Potential

Many energy experts believe that photovoltaics will be our principle source of energy later this century. A public/private partnership overseen by the U.S. DOE in 1997 concluded that photovoltaic technologies will become "the pervasive low-priced appliance of the latter half of the next century."[63]

The determining factor in how soon PV becomes dominant is not technical potential or available land. If all of current U.S. electricity use were generated by solar panels, the amount of space required would be one-fourth the amount of space taken up by the railroads.[64] We can afford this space for something as important as sustainable energy supply. The limiting factor in implementing wide-scale PV is cost.

Cost

For several years, solar panels have been cost-effective for niche uses such as roadside signs and other remote locations without existing power lines. Now the technology is at a point where photovoltaic panels can be cost-effective for grid-connected commercial and residential use.

Two things are needed to bring the cost of photovoltaics down further: R&D and economies of scale. Technology is evolving, with ongoing research continually leading to more efficient and inexpensive solar panels. And as PV manufacturers are able to build larger factories, production costs are lowered. Government should assist this development through a major procurement program.

Financing solar panels remains a problem. As long as individual consumers are expected to shoulder the burden of the initial investment hurdle, implementation of the technology will be slower than necessary. It is often difficult to roll the cost of solar panels into one's mortgage, and commercial loan rates are much less favorable. Public financing should therefore be available to help reduce the initial purchase and installation costs.

Another solution to this hurdle is municipal ownership of solar panels, but

U.S. Production and Installation of PV Panels (peak kW)[i]

Year	Domestic Production	Exports	Imports	Domestic Installations	Growth in Installations
1993	20,951	14,814	1,767	7,904	
1994	26,077	17,714	1,960	10,323	31%
1995	31,059	19,871	1,337	12,525	21%
1996	35,464	22,448	1,864	14,880	19%
1997	46,354	33,793	1,853	14,414	-3%
1998	50,562	35,493	1,931	17,000	18%
1999	76,787	55,562	4,784	26,009	53%

many states maintain barriers to this. Net metering caps in many states limit the amount of electricity that operators of solar panels can feed back into the grid. Federal law requires states to enact net metering laws. Most states have done this but have established caps on the size of array that can qualify for net metering, making it available only to individual consumers. If these caps are lifted, municipalities and solar power companies will be able to maintain ownership of panels installed on the sunniest rooftops in a community and operate them throughout their lifetime.

Solar thermal

Solar thermal power plants use reflectors to concentrate heat from sunlight. That heat is then used to drive turbines that produce electricity. The heat also can be stored to drive the turbines beyond sunlight hours. While photovoltaics are the appropriate technology for distributed generation at the point of use, solar thermal is the technology best suited for centralized generation distributed through power lines, as with traditional power plants. In addition, solar thermal technology is applicable to specialized distributed needs such as swimming pool heaters.

Capacity

Utilities have developed three different technology types of solar thermal power plants. The first of these — parabolic troughs — has been implemented by a utility in California. KJC Operating Company operates nine parabolic troughs with a combined capacity of 354 MW, equal to 90% of the solar thermal electricity generation in the world.[65]

In the 1990s, the rate of new installations of solar thermal collectors grew at an average of 3.3% per year, much of it for swimming pool heaters.

A second technology — power towers — shows great promise after successful trials, but has yet to enter the market. In 1996, a public/private consortium completed construction of a prototype 10 MW solar thermal plant in California that operates around the clock by storing heat in molten salt.[66] This project, know as Solar Two, successfully completed its demonstration phase in 1999 and continues to operate as a power source for Southern California Edison. Solar Two proved that molten salt storage is viable, and future solar thermal plants are expected to use this technology. While the technology and economics look promising, energy companies are reluctant to invest heavily in the new technology without public assistance.

U.S. Installations of Solar Thermal Collectors (thousand square feet)[j]

Year	New Installations	Growth
1993	8,596	
1994	9,037	5%
1995	9,173	2%
1996	9,092	–1%
1997	9,861	8%
1998	9,602	–3%
1999	10,398	8%

Potential

Solar thermal technology is powerful – 100% of current fossil fuel-based electricity production could be replaced by solar thermal plants on 1% of the earth's desert area.[67]

Although transmission distances may make generating all of our electricity in the deserts unfeasible, much development can take place before this presents a barrier. Clearly we should be taking advantage of every opportunity to use this resource to meet demand in regions surrounding areas of intense sunlight. As fuel cell technology develops, there will likely be opportunities to process hydrogen in the deserts for shipment elsewhere.

Cost

According to DOE's Sun-Lab, solar thermal power plants can now produce electricity for as little as 5.2 ¢/kWh, though many potential projects are currently available only at a cost of around 8–11 ¢/ kWh. They predict that this cost will decrease as low as 3.3 ¢/kWh by 2010.[68]

Geothermal

Pockets of heat lying below certain surface regions of the Earth can be tapped to drive turbines that generate electricity. Wells drilled into these geothermal reservoirs bring hot water to the surface, where it powers the turbines and is then reinjected into the ground. Direct use of geothermal energy is also becoming common to heat buildings using pumps and pipes extending into nearby low-temperature geothermal reservoirs.

Capacity

California, Nevada, Utah, and Hawaii currently have geothermal power plants with a combined capacity of 2,800 MW.[69]

Potential

The size of our geothermal resources is tremendous. The DOE estimates high-temperature geothermal potential in the U.S. to be more than 4,000 quads, more than forty times our total current energy use.[70] Much of this resource is concentrated in and around Nevada. While some of these geothermal pockets may be inaccessible due to technical or environmental concerns, geothermal proponents are hopeful that much of the resource is recoverable. New technology development is needed for drilling at high temperatures and through hard rock.

The geothermal industry estimates that geothermal energy could supply 10% of U.S. electricity supply by 2020.[71]

Cost

According to the National Renewable Energy Laboratory, the typical cost of producing electricity from geothermal wells has decreased 25% over the past two decades to 5 to 8 ¢/kWh, and is expected to drop to 3 to 5 ¢/kWh by 2007.[72]

According to the 1997 Technology Characterization documents from the Office of Utility Technologies at the U.S. DOE, a 48 MW flashed-steam geothermal plant producing 403 GWh/yr could be built for $66 million with an annual operating cost of $4.2 million. At 20% annual financing, this equals 3 ¢/kWh, much less than the 4½ ¢/kWh cost of coal and gas.[73] The Energy Information Administration's baseline for a least-cost 50 MW geothermal plant is $85 million for construction and $3.5 million per year for operation, equaling 3.4 ¢/kWh. Neither office estimates how many opportunities there are at this cost.[74]

Fuel cells

Hydrogen is the most basic and abundant element in the universe. Using technology akin to the common car battery, fuel cells combine pure hydrogen with oxygen from the atmosphere to form water. In the process, an output of energy is created.

Unlike solar, wind, and geothermal energy, hydrogen can be transported easily from its place of production to its place of use. We could have hydrogen processing plants powered by wind energy in North Dakota, geothermal wells in Nevada, and solar concentrators in the Mojave Desert that ship tanks of hydrogen to the rest of the country to power fuel cells.

Researchers have shown that fuel cell technology works. Many energy experts believe that fuel cells will be the technology of the future. However, significant barriers must be overcome before they will be able to dominate the marketplace, most notably the giant task of converting the nation's 200,000 gas stations to hydrogen stations and other infrastructure conversions. Estimates vary widely on how much time will be needed to overcome these barriers.

According to statements made by auto companies at European car shows, several companies, including Daimler-Chrysler, Toyota, and Honda, plan to mass produce and market fuel cell vehicles by 2004.[75] Busses may be the first market-ready fuel cell vehicles, since they are better able to handle large fuel cells that require less frequent refueling.

Summary of Policy Solutions

There are many practical and effective policy options available to the federal government to guide our energy system toward a clean and sustainable future. Each of the following policies, explored elsewhere in this paper, should be part of a national energy plan.

Conservation and Efficiency

- Provide consumers with energy efficiency incentives such as rebates for energy-efficient home appliances and construction.
- Maintain the residential air conditioning standard as previously finalized. Develop strong standards for commercial air conditioning and residential heating systems. Develop standards for appliances not currently covered by efficiency standards.
- Provide incentives to the largest industrial users of power to become more energy-efficient.
- Increase auto fuel efficiency standards and eliminate the SUV loophole.
- Create tax incentives for consumers to purchase low and zero emission vehicles. Encourage states to begin zero emission vehicle programs.
- Require real-time pricing structures for large industrial power users.

Clean and Sustainable Supply

- Require all electricity suppliers to buy a minimum of 10 percent of the power they sell to consumers from solar, wind and geothermal by 2010; 20% by 2020.
- Extend the wind energy production tax credit
- Coordinate and fund sustained R&D projects for renewable energy technologies.
- Provide a residential solar tax credit and a solar commercial production tax credit. Use existing federal loan and secondary financing programs as lending instruments for solar.
- Help renewable energy equipment manufacturers reach economies of scale by procuring renewable production for government and military facilities.
- Establish interconnection and net-metering regulations without caps, including a national technical interconnection standard.
- Clean up emissions from fossil fuel power plants for four major pollutants.
- Phase out nuclear power and require a democratic process to decide on the ultimate fate of nuclear waste.

Reliable and Affordable Supply

- Encourage renewable energy through measures outlined above.
- Cap wholesale and retail energy prices based on cost of production.
- Discourage concentration of ownership in the oil and electricity industries.

Harmful Policy Proposals

Members of the Bush administration have stated clearly that they intend to answer our current energy concerns with a supply-side strategy focusing on coal, gas, and nuclear fuels. Recent statements by Vice President Cheney about the White House Task Force on Energy indicate that the administration's plan will include increased oil and gas exploration and production, weakened environmental protections for air quality, increased subsidies for fossil fuel and nuclear energy, and a dramatic reduction in federal funding for renewable energy research and development.

Drilling in sensitive areas

The centerpiece of the Bush administration's energy plan is to increase domestic energy supplies of fossil fuels. The Bush plan encourages drilling for oil and natural gas in protected lands in the Rocky Mountains, along the Gulf Coast from Texas to Florida, and in the Arctic National Wildlife Refuge in Alaska. It also may include drilling in the Great Lakes and off the coast of California. If carried out, these plans could have devastating effects on a range of ecosystems, from those close to our major population zones to the most pristine wildlands left in the U.S. More than 31,000 gallons of oil already spill into U.S. waters every single day, and increases in oil and gas drilling would cause a further increase in this already dramatic figure.[76]

Plans are already underway to drill for natural gas in the eastern Gulf of Mexico. The Commerce Department is expected to decide this summer whether to allow the drilling of as many as 21 gas wells in the Destin Dome field just south of Pensacola.[77] And drilling in protected areas in the front range of the Rocky Mountains would also put added pressure on pristine wildlife habitat already suffering from encroaching development.

Gas drilling threatens sensitive land and water bodies on many levels. First, drilling operations require large-scale infrastructure for roads, pipelines, processing plants, and storage tanks, in addition to the rigs themselves. Constructing industrial operations in the middle of the wilderness inevitably damages the land. Second, leakage from the extraction, transportation, and storage of natural gas is a serious contributor to climate change, as natural gas itself is a greenhouse gas.

By far the most talked about oil drilling plans are on the coastal plain of the Arctic National Wildlife Refuge. Located at the far northeastern corner of Alaska, the refuge is the only piece of the north slope of Alaska that has not been drilled for oil. The USGS estimates that there may be up to six months worth of oil (at present U.S. consumption rates) under the refuge. If extraction were to begin immediately, the U.S. would not see this oil for another ten years.[78] There is no guarantee that any of this oil would ever reach U.S. consumers as most of the oil now produced in Alaska is exported to Japan.[79] The refuge, an ecological gem above the Arctic Circle, is host to countless bird species from every state in the lower 48, home of the 190,000 member porcupine caribou herd, and the last place in the United States where polar bears den.

Oil companies claim that advances in drilling technology would be less damaging than older technologies. This may well be true, but it is simply not possible to extract half a million barrels of oil per day without serious environmental consequences. No matter how much we improve all of these techniques, oil exploration inevitably results in spills.

- The Prudhoe Bay oil fields next door to the refuge present a vivid picture of the environmental damage caused by oil drilling. Prudhoe Bay is one of the most industrialized places on the planet. In 2000, the region suffered more than 400 oil spills involving tens of thousands of gallons of crude oil and other petroleum products.[80]
- On January 16, 2001, 20,000 gallons of drilling "mud" — a petroleum-based lubricant for drilling bits — spilled from one of Prudhoe Bay's newest facilities.[81]
- New computer-based exploration techniques designed to improve the probability of hitting oil can actually worsen environmental impacts because they require one hundred or more large trucks to crisscross the fragile tundra looking for oil.[82]

Weakened environmental standards

Environmental standards have not been the cause of tight energy supplies. In California, only one power plant was offline during recent rolling blackouts due to air quality violations, a small municipal plant in Glendale. Not a single power plant construction permit has been denied in the state in recent years.

The biggest factors in the slowed pace of power plant construction in the past decade were regular market cycles combined with market uncertainty resulting from pending deregulation. Energy producers in California did not apply for any major new plant permits from 1990 to 1998. In fact, they sued the EPA to get out of requirements to build new supplies. In addition, years of low gas prices discouraged industry investment; as a result, natural gas reserves held in storage in 2000 were down 20% from average levels.[83]

Now energy companies want to make up for lost time by building lots of new plants as quickly as possible. Vice President Cheney has announced that he intends to push for the construction of 1,300 large plants over the next twenty years, an average of three large power plants per Congressional district. To accomplish this, he proposes weakening environmental standards. Likely standards on the chopping block are those ensuring that plants are sited in the most appropriate locations and those requiring that all new plants use the best available technology to control emissions.

Promotion of nuclear power

Nuclear fission puts our lives at risk from potentially disastrous accidents and creates the most harmful substance known, for which there is no safe disposal process.

Direct exposure to irradiated fuel from nuclear reactors delivers a lethal dose of radiation within seconds. According to the Department of Energy, 95% of the radioactive waste in this country (measured by radioactivity) is from commercial nuclear reactors. The storage of this waste poses a threat to water supplies throughout the nation. At the Hanford Nuclear Reservation in Washington, 67 of 177 underground tanks have leaked more than one million gallons of waste, contaminating groundwater and threatening the Columbia River.[84]

Because energy companies have not begun construction on any new nuclear power plants in more than twenty years, it is easy to assume that we are at less risk from accidents than we have been previously. Actually, the reverse is true. Because many nuclear plants in the U.S. are decaying, the risk of accidents is greater. Nuclear plants do not get safer with age. They get more dangerous.

Vice President Cheney has stated that we should extend the life of existing nuclear plants. Were this to happen, the industry's abysmal record of safety violations would almost certainly get even worse.

Cheney also proposes to build new nuclear power plants. While improvements in technology would probably make the generation process safer at new plants compared with older plants, new nuclear plants are a bad idea because of waste and cost issues. We already have 34,400 metric tons of spent fuel in temporary storage in the U.S., and five metric tons more is added every day.[85] As there is no adequate solution to this problem, we should stop making it worse as soon as possible. And new nuclear plants would also be financially wasteful, as discussed below.

Increased subsidies for fossil fuels and nuclear

Fossil fuels and nuclear power have enjoyed enormous subsidies over the past century, outstripping funding for renewable energy development nearly eight to one.[86] Subsidies for fossil fuels dominate the federal tax code as well, with 62% of all federal tax expenditures going to oil and gas companies.[87] Rather than reversing these trends, the Bush administration proposes to pour more money into these outdated industries while failing to spur newer and better technologies.

Spending on research for so-called "clean coal" technology would increase under President Bush's proposed FY02 budget, from $71 million to $82 million.[88] Since 1984, this program has consumed more than $2 billion with little tangible benefit. The General Accounting Office has issued seven reports documenting mismanagement in the program and recently concluded that spending on clean coal research has been a waste of taxpayer money.[89]

Nuclear power would not exist in this country today were it not for enormous subsidies paid for by taxpayers and ratepayers. Taxpayer-financed federal R&D money alone has totaled $66 billion.[90] On top of that, the nuclear industry has received a special taxpayer-backed insurance policy known as the Price Anderson Act, taxpayer-funded cleanup of uranium enrichment sites, the costly privatization of the previously government-owned Uranium Enrichment Corporation, and unjustifiably high electricity rates from state regulators. Add to this the enormous bailouts in state deregulation plans that began a few years ago and will continue in the coming years. "Stranded costs" in just eleven key states may total more than $132 billion.[91]

Cuts in energy efficiency and renewable energy programs

Federal programs to boost energy efficiency are proven effective. The Department of Energy recently calculated $28 billion in energy savings from just five energy efficiency technologies it helped develop, more than the total energy efficiency and renewable energy budget of the past 25 years.[92] The DOE estimates that energy efficiency improvements could lead to savings of 10% of total energy use by 2010 and 20% by 2020.[93] Outside experts put these numbers even higher: 18% by 2010 and 33% by 2020.[94]

Renewable energy technologies also show great promise, and our national laboratories should lead the way. New technologies currently under development in government-led efforts include thin-film silicon photovoltaics, solar thermal power towers, liquid crystal PV, and advanced wind turbine airfoils.

In its FY02 budget, the Bush administration has proposed deep cuts in energy efficiency programs. The only program with a proposed increase in funding in the President's budget request is for the weatherization of low-income households. All other energy efficiency programs would be cut, from a total of $1.04 billion to $759 million.[95]

President Bush's proposed budget also cuts funding for renewable energy programs by more than half. Spending on solar programs would drop from $92.7 million to $42.9 million, and spending on wind projects would go from $39.6 million to $20.5 million.[96] The National Renewable Energy Laboratory would lose a third to one half of its staff due to funding cuts.

Conclusion

We are at a critical juncture. With energy demand increasing and energy markets not functioning well, we must decide on a set of national energy policies that will provide for our future energy needs. We can choose to continue our reliance on fossil fuels, or we can take this opportunity to consume energy more wisely and transform our energy infrastructure.

A century of reliance on fossil fuels and nuclear fission for our energy needs has come at great costs to public health and the environment, and has resulted in unstable supplies and price. We have built our society around commodities that are unreliable and do short-term and long-term damage to our health and our planet. As our energy use increases, these costs and instabilities will only grow worse. We need an energy policy that ensures reliable supply at stable prices produced with tolerable impacts.

In all sectors of energy use we still have much room for improvement in energy efficiency. Such improvements most often come more quickly than new supply options at a net savings to consumers. The U.S. also has tremendous potential for wind, solar, and geothermal energy production, and recent advances have made these technologies competitive with fossil fuels for many uses. Encouraging renewable energy suppliers with the same scale of incentives that oil, gas, coal, and nuclear energy have enjoyed throughout the past century would transform our energy production. Together, efficiency and renewables can bring us to a smarter, cleaner energy future.

Proposals from the Bush administration to increase available fossil fuel supplies will only exacerbate current problems associated with energy use and production. By deepening our reliance on limited fossil fuels rather than reducing this reliance, we will ultimately produce more market volatility, suffer more widespread environmental damage and health problems, and be more dependent on foreign oil. Instead, we should be taking advantage of effective and practical solutions to encourage energy conservation, energy efficiency, and renewable energy production.

Appendix A: Time Needed for Supply and Demand Options

Energy Efficient Light Bulbs: Compact fluorescent bulbs use one fourth the energy of incandescent bulbs, last ten times as long, and are more cost efficient. These bulbs would save the average household $35-$60 and avert 1.5 tons of global warming pollution annually.[97]

Weatherize Homes: This would drastically reduce energy demand. A homeowner can weatherize in less than a month, saving $200-$400 and averting ten tons of global warming pollution annually.[98]

Improve Fuel Efficiency of Light Trucks: Over the next ten years, fuel economy standards for all autos should be increased by 60% to save consumers billions at the pump and save more oil than we import from the Persian Gulf. As a first start, the Feinstein-Snowe bill (S. 804) would require light trucks and SUVs to meet current miles per gallon standards for cars, with an interim goal of a 2 mpg improvement by 2002. When fully implemented, the bill would reduce annual global warming pollution by more than 100 million tons and save consumers $11 billion at the gas pump.[99]

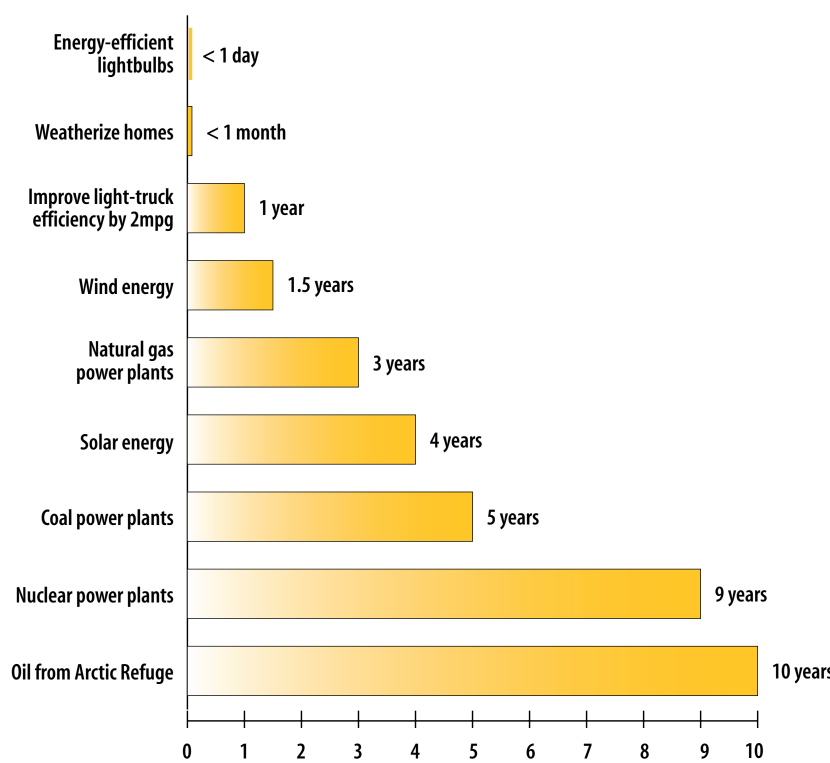
Wind Energy: According to the American Wind Energy Association, a typical 300 MW wind farm would take a year and a half to build. A farmer would receive $20,000 in annual lease payments for ten turbines and 95% of the land would still be used for farming.[100]

Natural Gas Power Plants: The Energy Information Administration (EIA) estimates that it would take three years for a utility to build a 300 MW natural gas power plant that could also burn oil. It would pollute less than a coal-fired power plant, but would still produce global warming pollution.[101]

Solar Energy: According to the Sacramento Municipal Utility District, it takes four years to build a 300 MW photovoltaic power plant. [102] Also, contractors can build a comfortable, affordable solar home in one week. [103]

Coal Power Plants: According to the EIA, utilities could build a new coal-fired power plant in five years. [104] Coal-fired power plants create soot and smog pollution that sends hundreds of thousands of Americans to emergency rooms and cuts short the lives of over 30,000 people each year.[105]

Nuclear Power Plants: According to an EIA study, it takes an average of nine years to build a nuclear power plant. The same study shows that nuclear power



plants typically cost three times industry estimates, relying on consumer bailouts and federal subsidies.[106]

Oil from the Arctic National Wildlife Refuge: According to a U.S. Geological Survey study, drilling in the Arctic National Wildlife Refuge would yield only a six month supply of oil that would take ten years to reach American consumers.[107] This small supply would have no impact on oil prices and much of it could be exported to Japan.

Appendix B: Wind Potential by State

Region	Wind Potential NREL Estimates	Wind Potential PNL Estimates	1999 Use (avg MW)	Potential Pct of Use NREL Estimates	Potential Pct of Use PNL Estimates	Excess (Need) NREL Estimates	Excess (Need) PNL Estimates
WY	49,339	85,000	1,399	3526%	6074%	47,940	83,601
MT	43,753	116,000	1,145	3822%	10134%	42,608	114,855
CO	23,350	54,900	4,677	499%	1174%	18,673	50,223
NM	13,262	49,700	2,067	642%	2405%	11,195	47,633
ID	2,151		2,488	86%		(337)	(2,488)
UT	803	2,770	2,506	32%	111%	(1,703)	264
NV	826		2,999	28%		(2,173)	(2,999)
OR	2,724	4,870	5,696	48%	86%	(2,972)	(826)
AZ	190	1,090	6,579	3%	17%	(6,389)	(5,489)
WA	3,417	3,740	10,622	32%	35%	(7,205)	(6,882)
CA	5,546	6,770	26,653	21%	25%	(21,107)	(19,883)
West	**145,361**	**324,840**	**66,830**	**218%**	**486%**	**78,531**	**258,010**
KS	88,406	121,900	3,856	2293%	3162%	84,550	118,044
ND	81,342	138,400	982	8280%	14088%	80,360	137,418
NE	72,510	99,100	2,601	2788%	3810%	69,909	96,499
SD	64,063	117,200	901	7113%	13012%	63,162	116,299
TX	87,285	136,000	34,425	254%	395%	52,860	101,575
OK	56,270		5,335	1055%		50,935	
MN	54,020	75,000	6,536	827%	1148%	47,484	68,464
IA	46,898	62,900	4,315	1087%	1458%	42,583	58,585
WI	4,631	6,440	7,296	63%	88%	(2,665)	(856)
AR	1,305		4,523	29%		(3,218)	
MO	3,156		7,827	40%		(4,671)	
IL	5,926	6,980	15,081	39%	46%	(9,155)	(8,101)
LA			8,954				
Central	**565,812**	**763,920**	**102,633**	**551%**	**744%**	**463,179**	**661,287**
VT	432	537	630	69%	85%	(198)	(93)
NH	528		1,111	48%		(583)	
RI	52		813	6%		(761)	
DE	256		1,227	21%		(971)	
ME	294	6,390	1,367	22%	467%	(1,073)	5,023
WV	555	594	3,098	18%	19%	(2,543)	(2,504)
CT	652		3,400	19%		(2,748)	
MA	2,225	2,880	5,789	38%	50%	(3,564)	(2,909)
MD	256		6,745	4%		(6,489)	

Region	Wind Potential		1999 Use (avg MW)	Potential Pct of Use		Excess (Need)	
	NREL Estimates	PNL Estimates		NREL Estimates	PNL Estimates	NREL Estimates	PNL Estimates
NJ	993		8,056	12%		(7,063)	
MI	4,063	7,460	11,784	34%	63%	(7,721)	(4,324)
NY	6,432	7,080	14,612	44%	48%	(8,180)	(7,532)
SC	44		8,358	1%		(8,314)	
KT	42		8,978	0%		(8,936)	
VA	706		10,609	7%		(9,903)	
TN	159	186	10,815	1%	2%	(10,656)	(10,629)
PA	4,491	5,120	15,232	29%	34%	(10,741)	(10,112)
IN	28		11,078	0%		(11,050)	
GA	62		12,775	0%		(12,713)	
NC	308		13,099	2%		(12,791)	
OH	343		18,810	2%		(18,467)	
MS			5,056				
AL			9,177				
FL			21,313				
East	**22,921**	**30,247**	**203,932**	**11%**	**15%**	**(181,011)**	**(173,685)**
Total	**734,094**	**1,119,007**	**373,394**	**197%**	**300%**	**360,700**	**745,613**

Sources: National Renewable Energy Laboratory, Pacific Northwest National Laboratory, Energy Information Administration. See note g.

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