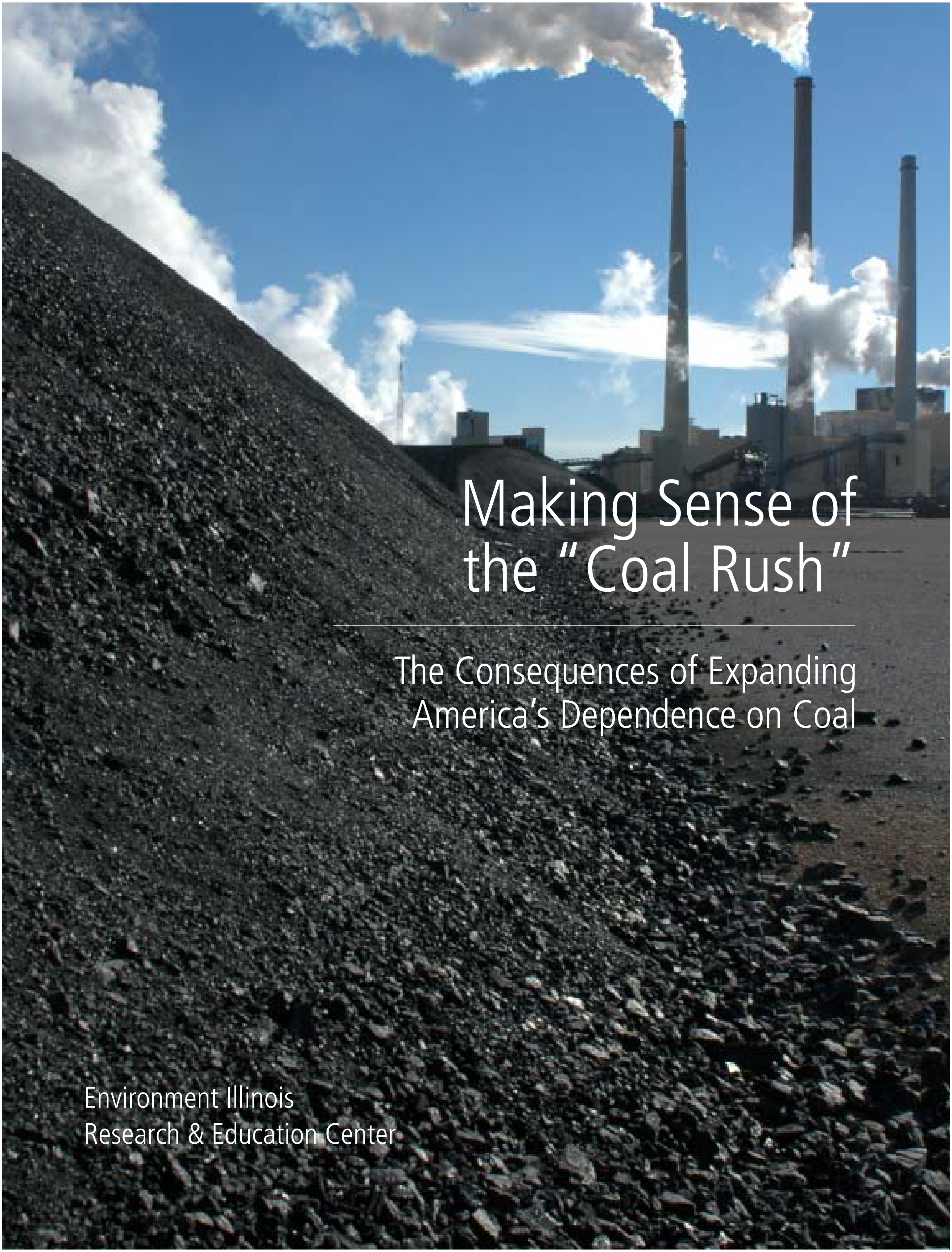

Making Sense of the "Coal Rush"

The Consequences of Expanding America's Depentence on Coal

Environment Illinois
Research & Education Center

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- *Making Sense of Hydrogen: The Potential Role of Hydrogen in Achieving a Clean, Sustainable Transportation System*, 2004, available at www.newenergyfuture.org.

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Executive Summary

Energy companies have proposed building a fleet of new coal-fired power plants across America. As of June 2006, power producers have approximately 150 new coal-fired plants on the drawing board, representing a $137 billion investment and the capacity to supply power to 96 million homes.

If energy companies succeed in building even a fraction of these new power plants, it would have major impacts on America's environment and economy. Further, this "coal rush" would consume investment dollars that could otherwise promote more sustainable energy sources.

Fortunately, alternatives exist that would reduce or eliminate the need for new coal-fired power plants. By funneling investment instead into improvements in energy efficiency and expansion of renewable energy, the U.S. can avoid the potential impacts of the "coal rush" and improve the economy, the environment and public health.

The "coal rush" would increase U.S. global warming pollution at a time when aggressive action is needed to reduce emissions.

- To avoid the worst consequences of global warming, scientists believe that the U.S. needs to stabilize emissions within a decade, begin reducing them soon thereafter, and cut global warming pollution by as much as 80 percent by the middle of this century. New coal-fired power plants will take us in the wrong direction.
- If all of the proposed plants are built, they would increase U.S. carbon dioxide pollution from electricity generation by more than 25 percent above 2004 levels. This would be equivalent to a 10 percent increase in total U.S. emissions and a 2.4 percent increase in world emissions.
- The vast majority of proposed plants use traditional coal-burning technology, which emits massive amounts of carbon dioxide. Only 16 percent of the proposed plants would use coal gasification technology and could someday be equipped to capture and store carbon dioxide. Even these plants would require costly future upgrades to avoid large releases of global warming pollutants.

Increasing America's dependence on coal carries significant economic risks for power generating companies, their shareholders, utility ratepayers, and the economy as a whole.

- The growing urgency of addressing global warming makes limits on carbon dioxide pollution a virtual certainty for the future. As these limits are set, coal-fired power plants will decline in value compared to less-polluting resources. Additionally, companies or ratepayers may be forced to pay the significant cost of retrofitting the new plants to capture and store carbon dioxide.
- Companies that build coal-fired power plants today knowingly and significantly contribute to the public health, environmental and property damage that will result from global warming. Such companies face potential legal risks, similar to the lawsuits filed against the tobacco industry in the last decade.
- The new coal-fired power plants, if built, will strain the U.S.'s ability to extract and deliver enough coal to keep them running. U.S. coal demand would increase by over 30 percent if all the plants are built, requiring additional mines and expanded railroad infrastructure to move the coal around the country.

Mining additional coal would damage America's land and water.

- According to the U.S. Department of Energy, currently operational coal mines have enough recoverable coal to supply the power industry for only 18 years at current levels of demand (and fewer years if demand increases).
- While the U.S. has enough coal supplies to sustain current levels of consumption for nearly 200 years, extraction of that coal is likely to damage wide areas of land now used for agriculture, housing and recreation, while fouling water supplies and harming wildlife.
- Between 1985 and 2001, "mountaintop removal" coal mining in Appalachia cut down more than 7 percent of the region's forests and buried more than 1,200 miles of streams.
- In 2004, coal mines across the U.S. reported the release of more than 13 million pounds of toxic chemicals, including over 300,000 pounds dumped directly into streams and rivers.

The "coal rush" would increase health-threatening air pollution.

- If all of the planned coal-fired power plants are built, they would increase total pollution from power plants and other industrial facilities on the order of 1 to 3 percent, including:
  - 120,000 tons per year of sulfur dioxide, a major ingredient in fine particle pollution, linked to premature death and respiratory and cardiovascular disease;
  - 240,000 tons per year of nitrogen dioxide, a major ingredient in the photochemical smog that plagues many cities across the U.S. on summer days; and
  - 3 tons per year of mercury, a neurological toxicant that contaminates fish in rivers, lakes and the oceans.

The "coal rush" would consume investment dollars that could be used to promote safe and sustainable energy sources, including energy efficiency and renewable energy.

- Building all of the coal-fired power plants on the drawing board would require capital investment of

$137 billion. On top of that, energy companies would have to spend more than $100 billion to operate, maintain and fuel the plants and build transmission lines.

- If that $137 billion in capital were instead directed toward energy efficiency, it could reduce electricity demand in 2025 by about 19 percent compared to a business-as-usual forecast (1 million GWh/year), without additional investment for transmission and distribution. In other words, energy efficiency could completely alleviate the need to build any new coal-fired power plants—and do so for less cost and with zero global warming pollution.
- Directed instead toward renewable energy, that $137 billion could develop 110 GW of the best wind resources in the western U.S. with a cost of electricity comparable to conventional coal. Alternatively, the money could build over 50 GW of promising zero-emission solar technologies like concentrating solar thermal power plants—predicted to provide electricity at prices competitive with coal within the next 10 years, with the potential to supply energy day or night using thermal storage.
- Wind, solar, tidal, geothermal and biomass resources—coupled with energy-saving renewable technologies such as passive solar heating and lighting, solar hot water heating and geothermal heat pumps—could provide a large and growing share of America's energy. A consistent emphasis on renewables in public policy and in research and development funding could bring many of these technologies into the mainstream—but not if America's investment dollars are staked on coal.

Citizens and government should act to stop the "coal rush" and instead pursue a cleaner, more sustainable path to satisfying America's energy needs.

- States and the U.S. as a whole should impose strong caps on global warming pollution from power plants at levels that are sufficient to minimize human interference with the global climate—on the order of 80 percent below 1990 levels by mid-century.
- States and the federal government should not allow any new coal facility to be built, unless:
  - *All* the costs of coal-fired power plants—including the societal cost of global warming and the probable cost of additional pollution control requirements—are fully considered when utility investment decisions are made;
  - Gasified coal with carbon storage is demonstrated to be the least-cost way to reduce global warming pollution consistent with climate stabilization goals, compared to other clean resources that could satisfy or reduce energy demand, such as renewable energy and energy efficiency; and
  - Any new gasified coal plants with carbon storage are used to replace old, inefficient coal-fired power plants, not augment them.
- Public funds should not be used to support the construction of any coal-fired power plants.
- Leaders at all levels of government should take aggressive action to encourage the development of cleaner alternatives to coal-fired power plants, particularly measures to improve energy efficiency and encourage the development of clean renewable resources.

Introduction

America is at an energy crossroads. Across the country, policy makers, experts and ordinary Americans are debating which path to take to satisfy our energy needs. When it comes to electricity, for example, should we rely on natural gas, which is relatively clean-burning but also increasingly scarce? Or should we cast our lot with nuclear power, which is both expensive and risky? What about "clean coal," which television ads tell us can be environmentally friendly after all? Or is there some way to shift more of our energy production to clean renewable sources like solar and wind power?

This energy debate is taking place in boardrooms and classrooms, at kitchen tables and on the Internet. But while the American people are talking, utilities and power generators are laying the groundwork for their own vision of America's energy future.

And that future looks an awful lot like the past.

It is a future of dozens, perhaps hundreds of big coal-fired power plants—most of them using traditional "dirty coal" technology—sprouting up across the country, from Florida to Washington state and from Texas to Pennsylvania.

It is a future of continued mercury and soot pollution from power plant smokestacks, of landscapes denuded and waterways fouled by mining operations, and of massive emissions of the greenhouse gases that have already begun to warm the globe and that threaten unimaginable harm to our environment, economy and society in the years and decades ahead.

It is a future in which Americans feel constrained by the bad policy decisions and bad investments of the past—unable to make the transition to a cleaner, more sustainable energy system that is more protective of the environment and the economy.

It is also the future toward which we are headed—unless we act now.

The recent boom in proposals for coal-fired power plants—the "coal rush"—threatens to undermine efforts to protect the environment and slow global warming, and could saddle the nation with a wide range of economic risks.

But such a path is not inevitable. America has at hand a variety of better solutions to its energy problems. Technologies exist that can dramatically reduce our consumption of energy, while at the same time drawing more of that energy from clean, renewable sources. Pursuing such a "new energy future" would free America from much of its dependence on fossil fuels, allow the nation to do its part to reduce global warming, create jobs, and safeguard America's future economic and national security.

This paper describes the dangers posed by the "coal rush" and proposes policy changes and other actions that can head off an ill-considered rush to build coal-fired power plants, while putting America on a more sensible energy path. Policy-makers and all Americans need to understand the implications of the "coal rush" and take action to stop it, before the nation is irrevocably set on a road to the wrong energy future.

The "Coal Rush"

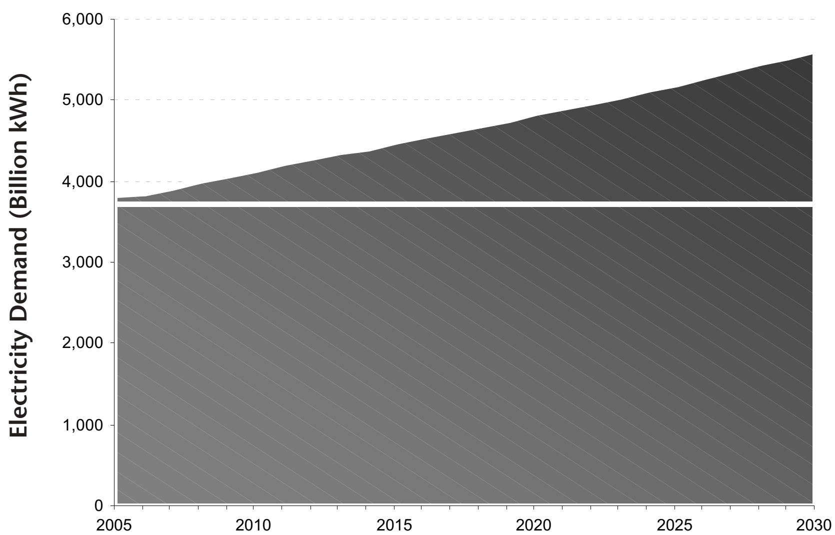
America's Energy Crossroads

America faces tough choices about how the nation will serve its electricity needs.

Should the nation continue consuming electricity along a "business as usual" path, demand for electricity will grow dramatically over the next several decades. Forecasts by the U.S. Energy Information Administration (EIA) predict that electricity consumption will grow 45 percent in the next 24 years.[1] (See Figure 1.)

In the past, policy-makers have taken growing demand as a given, and have encouraged various strategies to serve that demand. Many of those approaches imposed

Figure 1: Projected U.S. Electricity Demand[2]



unnecessary costs that are still affecting us today.

For much of the 20th century, utilities mainly attempted to meet increasing demand by building coal-fired power plants.[3] For much of this period, there was little understanding of how power plant pollutants such as mercury, sulfur dioxide and soot could affect human health and the environment. And until the late 1980s, there was very little understanding of the impact of carbon dioxide emissions on the global climate. Today, we continue to grapple with the public health and environmental problems caused by those power plants, while ratepayers have been called upon to finance the installation of pollution control equipment to reduce environmental impacts.

During the 1960s and 1970s, utilities responded to projections of rapid demand growth by encouraging the construction of nuclear power plants. Despite initial promises that nuclear power would be "too cheap to meter," nuclear power turned out to be an economic disaster, requiring well over $100 billion in government subsidies, causing electricity rates in states that invested heavily in nuclear power to skyrocket, and saddling ratepayers with billions of dollars in capital costs which are still being paid off today.[4] In addition, nuclear reactors have created more than 50,000 tons of toxic, radioactive waste and continue to pose significant threats to public health and safety.[5]

In the 1990s, the answer was natural gas. The boom in natural gas power plant construction was in part predicated on the notion that natural gas supplies would remain cheap for the foreseeable future—just as coal is being portrayed as an infinitely available, cheap source of energy today. It didn't turn out that way. In recent years, natural gas shortages and price spikes have reverberated throughout the economy. Natural gas prices have doubled in recent years, squeezing the pocketbooks of consumers and the profit margins of industry; both of whom have become increasingly dependent on natural gas for electricity, heat, hot water and as a raw material.[6] Limited supplies of natural gas make it clear that drilling our way out of the natural gas crisis is not an option.[7]

Now, the energy industry is turning back to coal.

A Return to Coal?

At first glance, coal appears to face none of the problems affecting natural gas. It is domestically available and relatively abundant. Compared with nuclear technology, coal-fired power plants have a simpler permitting process and do not produce dangerous radioactive waste.

Hoping to take advantage of these perceived advantages, utilities and power generators are proposing to build a vast new fleet of coal-fired power plants across America. As of June 2006, utilities have approximately 150 new coal-fired power plants on the drawing board, representing

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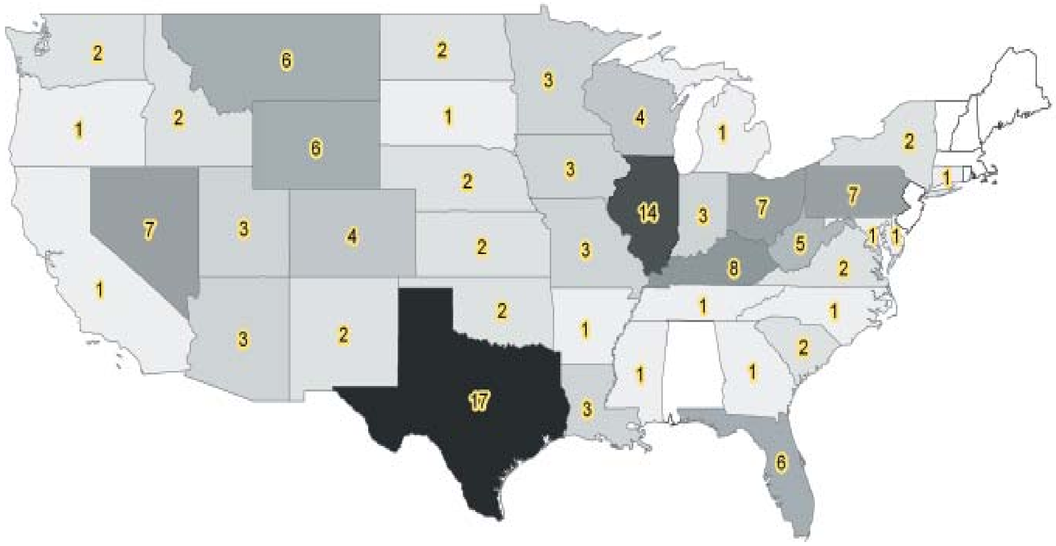
Tracking Coal-Fired Power Plants

To develop the list of coal-fired power plants on the drawing board, we began with a database of proposals compiled by the U.S. Department of Energy, dated March 2006.[10] The plants listed in the database are at various stages in the approval process—some are only proposals and may never move beyond that stage, some are in permitting, and some are approved and already under construction. We updated the list with changes we were aware of as of June 2006. These changes may not be fully comprehensive; it is possible that we are not aware of new proposals or changes in the status of existing proposals. The full list of proposed facilities, sizes and locations can be found in the appendix to this report on page 42, where additions and deletions to the DOE list are indicated.

$137 billion in investment and the capacity to supply power to 96 million homes.[8] (See "Tracking Coal-Fired Power Plants," above.) If all of these plants are built, it would increase America's coal-fired generation capacity by nearly 30 percent.[9]

Plants have been proposed in 42 states.[11] (See Figure 2.) At least one plant is proposed in every state west of the Mississippi. Texas leads the pack with 17 new coal units proposed, with Illinois following closely behind at 14. Other major locations for proposals include Kentucky (8), Nevada, Ohio and Pennsylvania (7 each), and

Figure 2: Proposed New Coal-Fired Power Plants by State[13]



Over 150 coal-fired power plants could be sprouting up across the country, from Florida to Washington state and from Texas to Pennsylvania. Numbers reflect proposals for new plants as of June 2006—not all of which will necessarily move forward. In addition, 3 plants have been proposed in Alaska and 4 proposals do not yet have locations.

The Frontier Line

In 2006, seven utility companies and four governors of Western states announced support for a massive new transmission line that would carry electricity from the coalfields of Wyoming to highly populated areas in California and Nevada.[17] The project, known as the "Frontier Line," would cost $4 to $6 billion and carry as much as 14,000 MW of power from Wyoming and Utah.

Separately, the Governors of California and Wyoming pledged to pursue investments in coal gasification plants. However, there is no legal limit to how much conventional and dirty coal energy the Frontier Line could carry. In 1996, the Federal Energy Regulatory Commission (FERC), which regulates the interstate transmission of electricity in the U.S., issued an order requiring that the owners of transmission lines provide open, non-discriminatory access to their lines in order to facilitate the development of wholesale electric markets.[18] Because of this policy, the Frontier Line could serve as a conduit to support a huge expansion of conventional and dirty coal plants, even if proponents claim it will carry energy from wind and "clean coal."

Florida, Montana and Wyoming (6 each).[12]

Not all of these proposals are equally likely to move forward. Regulatory hurdles or shifting investment decisions by power generators could mean that some of these plants will never move past the proposal stage, even without opposition.

However, some of these plants have already been approved and are under construction. Tuscon Electric Power is building a 400 MW plant in Springerville, Arizona. LS Power Development started construction on a 665 MW plant in Osceola, Arkansas this March. Xcel Energy broke ground on a 750 MW supercritical coal-fired plant in Pueblo, Colorado at the end of 2005. Mid-American Energy is building another supercritical facility in Iowa, scheduled to begin operation in 2007. Omaha Public Power District is now building a plant in Nebraska. Santee Cooper recently began construction of two plants in South Carolina. Wisconsin utilities have already begun construction on two new plants and two new plants are under construction in Wyoming.[14]

The number of proposals has increased rapidly in the first half of 2006. In April, TXU Corporation announced plans for eight new coal-fired power plants in Texas, in addition to three previously announced projects. In total, TXU plans to invest $10 billion in 8,600 MW of coal-fired capacity.[15] In June, NRG Energy announced six new coal-fired projects in Connecticut, Delaware, Louisiana, New York and Texas —part of a $16 billion expansion plan.[16]

In addition, energy companies have begun planning transmission infrastructure to support many of the planned coal-fired plants, enabling electricity from plants in the center of the country to serve large coastal markets. (For example, see "The Frontier Line" above.)

If even a fraction of the proposed new power plants are built and start operation, America's environment and economy will face serious consequences.

Consequences of the "Coal Rush"

Construction of new coal-fired power plants on such a massive scale would extend U.S. overdependence on coal for another half-century, with major impacts on America's environment and economy. It would commit the U.S. to an enormous increase in global warming pollution; risk financial harm to individual power companies, ratepayers and the U.S. economy; damage wide areas of land and foul water supplies with mining waste; and create health-threatening air and water pollution. Furthermore, staking America's energy future on coal would consume billions of dollars that could otherwise promote more sustainable energy sources.

Increased Global Warming Pollution

A new fleet of coal-fired power plants will dramatically increase U.S. global warming pollution, increasing the severity of the impact of global warming on current and future generations of Americans.

Global Warming Will Have a Severe Impact

Global warming threatens to significantly increase temperatures across America and around the world, causing dramatic changes in our economy and quality of life. Vast amounts of scientific evidence show that global warming is happening, and that human activity is the primary cause.[19]

By burning fossil fuels, humans have changed the composition of the atmosphere. As a result, it now traps more of the sun's heat near the Earth's surface. The leading culprit is carbon dioxide, the product of fossil fuel combustion. Carbon dioxide levels in the atmosphere are now increasing faster than at any time in the last 20,000 years, and are likely higher now than at any point in the last 20 million years.[20]

As carbon dioxide levels have risen, global temperatures have increased. In the last century, global average temperatures rose by about 1.4 degrees Fahrenheit—an unprecedented event in the past thousand years.[21] The 1990s were the warmest decade in a millennium and 2005 was the hottest year in over a century of record-keeping.[22]

This warming trend cannot be explained by natural variables – such as solar cycles or volcanic eruptions. However, it does correspond to models of climate change based on human influence.[23]

The Intergovernmental Panel on Climate Change (IPCC) predicts that global average temperatures could rise by between 2.5° and 10.4° F by the end of the century, depending on how society responds to the threat.[24] Recent research suggests that the IPCC may have underestimated the extent to which feedback loops could increase the warming effect—meaning that temperatures could actually rise by as much as 14° F by 2100.[25]

Climate scientists warn that the world faces dire environmental consequences unless we find a way to quickly and rapidly reduce our emissions of global warming pollutants.

Many scientists and policy-makers (such as the European Union) recognize a 3.6° F (2° Celsius) increase in global average temperatures over pre-industrial levels as a rough limit beyond which large-scale, dangerous impacts of global warming would become unavoidable.[26] Even below 3.6° F, significant impacts from global warming are likely, such as damage to many ecosystems, decreases in crop yields, sea level rise, and the widespread loss of coral reefs.[27]

Beyond 3.6° F, however, the impacts of global warming become much more severe, including some or all of the following impacts:

- Eventual loss of the Greenland ice sheet, triggering a sea-level rise of 7 meters over the next millennium (and possibly much faster)[28];
- A further increase in the intensity of hurricanes;
- Loss of 97 percent of the world's coral reefs;
- Displacement of tens of millions of people due to sea level rise;
- Total loss of Arctic summer sea ice;
- Expansion of insect-borne disease;
- Greater risk of positive feedback effects—such as the release of methane stored in permafrost—that could lead to even greater warming in the future.[29]

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At temperature increases of 5 to 7° F, far more dramatic shifts would take place, including:

- Increased potential for shutdown of the thermohaline circulation, which carries warmth from the tropics to Europe;
- Increased potential for melting of the West Antarctic ice sheet, triggering an eventual 5 to 6 meter rise in sea level;
- Major crop failures in many parts of the world;
- Extreme disruptions to ecosystems. [30]

In addition, the more global temperatures rise, the greater the risks of abrupt climate change increase. The historical climate record includes many instances in which the world's climate shifted dramatically in the course of decades, even years—with local temperature changes of as much as 18° F in 10 years.[31]

Should the world continue on its current course, with fossil fuel consumption continuing to rise, temperature would likely increase beyond the threshold for dangerous climate change—and continue to rise for generations to come.[32]

To Avoid the Worst Impacts of Global Warming, We Must Reduce Emissions Now

Minimizing the threat of global warming requires deep cuts in global warming pollution. To have a reasonable chance of keeping global temperatures from rising by more than 3.6° F, the atmospheric concentration of carbon dioxide must be held below 450 parts per million (ppm)—about 60 percent higher than pre-industrial levels and about 18 percent higher than today.[33] Holding concentrations below 400 ppm would be even more effective.

To stabilize carbon dioxide levels at 450 ppm, however, the world will need to halt the growth of global warming pollution in this decade, begin reducing emissions soon, and slash emissions by more than half by 2050.[34] Greater reductions would be required to limit carbon dioxide levels to 400 ppm. Because the U.S. is the world's largest global warming polluter, the degree of emission reductions required here will be greater. For example, the European Union has set a goal of cutting emissions by 15 to 30 percent below 1990 levels by 2020 and 60 to 80 percent by 2050.[35] To the extent that current forecasts underestimate the potential for feedback loops to trigger greater warming, pollution may have to be cut deeper and more rapidly to stave off the worst effects.[36]

If U.S. power companies build a new fleet of coal-fired power plants—even a fraction of the proposed number—it will become far more difficult to achieve reductions in global warming pollution on this scale.

The "Coal Rush" Will Make Global Warming Worse

Coal has an oversized impact on global warming. Burning coal in a conventional coal-fired power plant is the most carbon-intensive way to generate a kilowatt-hour of electricity. In 1999, coal-fired power plants in the U.S. produced over 2 pounds of carbon dioxide per kWh, while gas-fired plants produced over a third less. (See Table 1.) Coal is responsible for 84 percent of all carbon dioxide pollution from electricity generation in the U.S.[37] (See Figure 3.)

Overall, coal is responsible for about one-third of all emissions of carbon dioxide in America. Indeed, carbon dioxide emissions from coal-fired power generation in America alone exceed the total emissions of any nation in the world, except China.[38] Further, carbon dioxide emissions from coal burning have been increasing, up 24 percent since 1990.[39]

The "coal rush" would drastically increase U.S. global warming pollution. If all of the planned coal-fired power plants are built, they would increase annual

Table 1. Carbon Dioxide Emission Rates by Fuel[40]

Fuel	Output Rate (pounds CO_2 per kWh)
Coal	2.095
Petroleum	1.969
Natural Gas	1.321

electricity-related carbon dioxide pollution by more than 25 percent above 2004 levels (an increase of 590 million metric tons).[42] (See Figure 4.) This translates to a 10 percent increase in overall U.S. carbon dioxide pollution (compared to 2004) and a 2.4 percent increase in global emissions.[43] Assuming plants built during the coal rush have 60-year lifetimes, they would emit over 35 billion metric tons of global warming pollution.

The New Coal-Fired Power Plants: Same as the Old Ones

Proponents of coal as an energy source often point to coal gasification technology as an environmentally responsible way to use coal, with lower overall pollution. For example, General Electric has been running a series of television advertisements promoting its "clean coal" technology as a way to solve America's energy problems.[44]

Gasified coal technology, such as integrated gasification combined cycle (IGCC), does have some modest advantages over conventional pulverized coal technology: it is slightly more efficient and has lower emissions of conventional pollutants.[45] In addition, gasification technology transforms coal into a mixture of gases before burning it, making it possible to capture carbon dioxide before it heads up the smokestack. The federal government, in partnership with the power industry, is studying the possibility of storing carbon

Figure 3: Carbon Dioxide Pollution from Coal-Fired Power Plants[41]

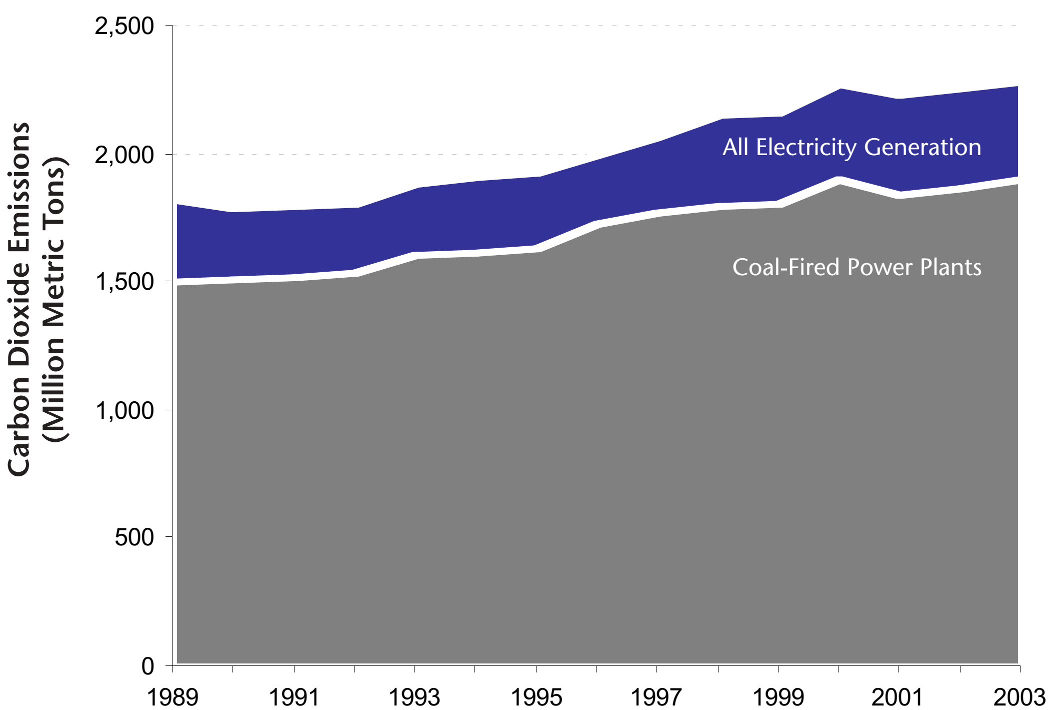
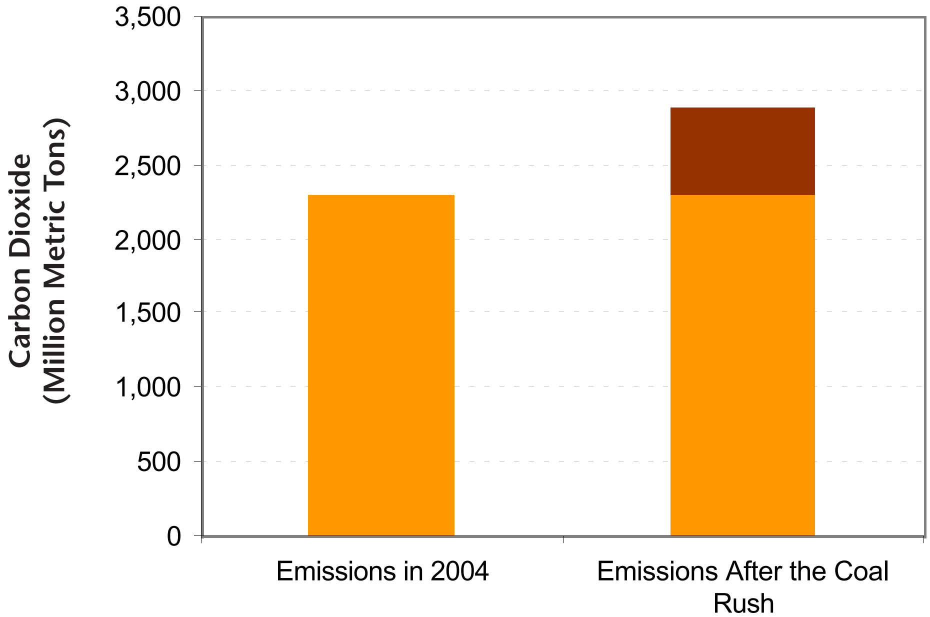


Figure 4: Impact of the Coal Rush on Carbon Dioxide Pollution from Electricity Generation



dioxide in large quantities underground—which would theoretically allow for the production of low- or zero-carbon power from coal.[46]

But while IGCC technology may be the one option for the coal industry to demonstrate it can be part of a global warming solution, there is one problem: gasification plants are not the kind of coal plants electricity companies are proposing to build.

Only 16 percent of currently proposed coal-fired power plants would use gasification technology, and only the Department of Energy's FutureGen demonstration plant is proposed to incorporate carbon capture and storage. Most of the proposed plants use conventional design. (See Table 2). As a result, many of the coal plants, if built, will not be well suited to the carbon capture and storage process that many see as the only way to use coal without a huge increase in global warming pollution.

Even if all of the new coal-fired power plants were to use gasification technology with carbon storage, the approach remains expensive, and no industry or country has yet demonstrated the feasibility of permanently storing billions of tons of carbon dioxide underground. (See "Gasified Coal and Global Warming" on page 18.)

In sum, the "coal rush" now being planned by electricity companies does not match up with the rhetoric touting coal as a clean and environmentally friendly source of power. Rather, it would commit the U.S. to the expansion of traditional coal-fired

Table 2: Proposed Coal-Fired Power Plants by Type[47]

Technology	Number	Percentage
Conventional Pulverized Coal	89	59%
Coal Gasification (IGCC)	25	16%
Circulating Fluidized Bed	22	15%
Supercritical Pulverized Coal	10	7%
To Be Determined	5	3%

Gasified Coal and Global Warming

Some energy companies are promoting gasified coal as an environmentally responsible way to use coal to generate electricity. However, high costs and technological hurdles make this technology less than ideal as a solution to global warming.

Coal gasification is more expensive than cleaner and more sustainable ways of addressing our nation's energy-related and environmental problems. Coal gasification with carbon storage is more than twice as expensive as typical energy efficiency measures and more than 50 percent more costly than the best wind power projects.[48] (See Figure 5). Even without carbon storage, the most optimistic forecasts by the research arm of the electric industry, the Electric Power Research Institute (EPRI), put the price of coal gasification at around 4.7 cents per kWh in 2010—close to 200 percent more expensive than a well-executed energy efficiency program.[49] However, EPRI predicts that the average cost of wind power will drop 30 percent between 2010 and 2020, and by 2020, both wind and biomass energy will be significantly cheaper than any type of coal power plant with carbon storage.[50]

Moreover, carbon capture and storage—on the scale at which it must be implemented to fight global warming—is an immature technology with serious questions about its future viability. Carbon dioxide has been injected into the ground for some time to enhance oil recovery. However, the storage of captured carbon dioxide from utility operations would require a vast expansion of carbon transportation infrastructure and identification of storage locations with huge capacity. Storing all U.S. power plant coal emissions would require enough infrastructure to liquefy, transport and inject roughly 2 billion metric tons of carbon dioxide annually.[52] Currently, there are only 21 demonstration projects in the world, and not one of them is large enough to store the lifetime emissions of even one power plant.[53]

Storing any quantity of carbon dioxide presents problems. As with nuclear wastes, carbon dioxide stored in geological formations must be guaranteed to remain underground for hundreds or thousands of years to prevent re-release to the atmosphere and to prevent accidental, large-scale releases of carbon dioxide, which can be fatal to humans and wildlife. Recent studies indicate that carbon dioxide acidifies saline aquifers, which can degrade some of the concrete-like minerals that seal holes in the rock, or concrete plugs in old oil and gas wells, raising questions about the permanence of storage.[54] Ocean storage, which has been considered a possible option for carbon management, appears less attractive given recent research tying increasing ocean carbon dioxide levels with acidification and damage to ocean ecosystems.[55]

Provided that the technological hurdles can be overcome, IGCC will likely only become a key player in the energy mix if policies are in place to make it economically competitive with conventional coal technology. A carbon cap that places a market price on carbon dioxide emissions from power plants could provide an incentive for cleaner technologies such as IGCC to develop. Even then, however, IGCC power plants would only deliver global warming benefits by replacing existing dirty and inefficient coal-fired power plants—not by adding to them.

power plant technology and to a large increase in global warming pollution. At a time when policy-makers and scientists across the world are struggling to find ways to avoid the most dangerous effects of global warming, allowing the coal rush to take place as planned would be beyond unwise—it would be thoroughly reckless and irresponsible.

Risk for Energy Companies, Shareholders, Ratepayers and the Economy

Increasing America's dependence on coal carries significant economic risk for electricity companies, municipally and cooperatively owned utilities, ratepayers and shareholders, and for the economy as a whole.

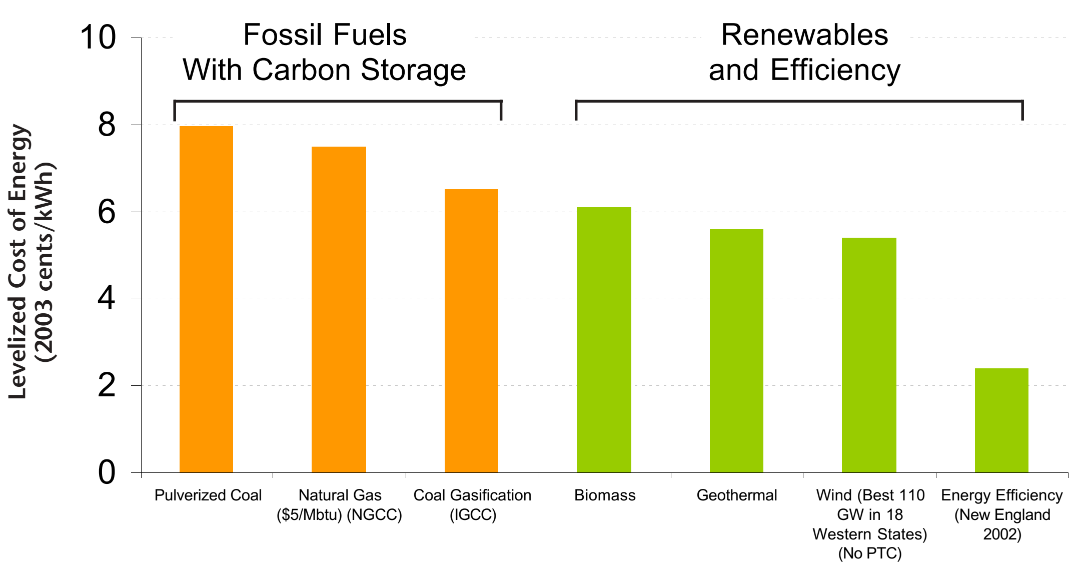
Global Warming Pollution Limits

Any new coal-fired power plants would be built in the face of incontrovertible evidence that carbon dioxide emissions are causing the planet to warm. There is growing consensus, even within the United States, that concerted action must soon be taken to curb global warming emissions.

For example:

- In early 2005, the Kyoto Protocol, which calls for significant global warming emission reductions in the world's industrialized countries, went into effect. A total of 163 nations, not including the United States, have signed on to the protocol.[56]
- In June 2005, The U.S. Conference of

Figure 5: Cost Comparison of Climate-Neutral Energy Sources[51]



Mayors voted unanimously in favor of the Climate Protection Agreement, which matches the Kyoto Protocol's goal of reducing global warming pollution by 7 percent below 1990 levels by 2020. The Conference represents 1,183 cities from all 50 states.[57]

- Governor Bill Richardson of New Mexico issued an executive order in June 2005 setting a series of global warming pollution reduction targets, including 10 percent below 2000 levels by 2020 and 75 percent below by 2050.[58]
- Governor Arnold Schwarzenegger of California (the state with the second-highest emissions of carbon dioxide) has issued an executive order setting a global warming pollution reduction target of 80 percent below current levels by 2050.[59]
- In February 2006, the California Public Utilities Commission responded with a unanimous decision to adopt a cap on global warming pollution for electricity retailers.[60]
- During its adoption of the 2005 Energy Policy Act, the U.S. Senate approved a "sense of the Senate" resolution stating that "Congress should enact a comprehensive and effective national program of mandatory, market-based limits and incentives on emissions of greenhouse gases that slow, stop, and reverse the growth of such emissions."[61]
- In 2005, seven northeastern U.S. states reached an agreement on the Regional Greenhouse Gas Initiative (RGGI), a program designed to reduce carbon dioxide pollution from power plants.[62] Subsequently, Maryland adopted a law that joins Maryland to the RGGI pact and sets tougher emission limits on the seven dirtiest power plants in the state.[63]
- A coalition of up to ten states has filed several lawsuits against the U.S. Environmental Protection Agency for refusing to regulate carbon dioxide pollution, most recently in April 2006.[64] In June 2006, The U.S. Supreme Court agreed to hear an appeal of one of these cases.[65]

Coupled with other nascent efforts to regulate carbon dioxide pollution in several regions in the United States, these actions suggest that the time is coming soon when carbon dioxide pollution will be regulated or discouraged through emission trading schemes, carbon taxes or other measures.

Financial Risk

As global warming pollution limits are set, coal-fired power plants will decline in value compared to less-polluting resources. Additionally, companies or ratepayers may be forced to pay the significant cost of retrofitting the new plants to capture and store carbon dioxide.

Some electricity resource planners argue that future costs associated with global warming regulations are too uncertain, and thus leave estimates out of planning decisions altogether. However, this omission effectively assigns future carbon emissions a cost of zero—which is not accurate, especially not over the 50 years a new power plant could operate. According to a recent analysis by Synapse Energy Economics, one ton of carbon dioxide pollution will likely cost between $10 and $40 in 2010; and between $20 and $50 in 2030.[66] Synapse bases its calculations on relatively modest policy proposals that have been made to date—not on the more stringent emission cuts that will be necessary to avoid the most dangerous consequences of global warming.

Companies that choose to move forward with coal-fired plants in the face of this knowledge expose themselves, their shareholders and their ratepayers to a substantial economic risk. Owners of coal-fired power plants could be required to pay for the right to emit carbon dioxide into the environment—either through a carbon tax designed to reduce emissions or through the purchase of pollution permits in an emission trading scheme. In either case, the cost of producing electricity from coal-fired power plants would increase and the value of those plants relative to other, less carbon-intensive forms of generation would decline.

Another possible scenario is that coal-fired power plant owners would be required to install equipment to capture and store carbon dioxide emissions from the plant. Such investments are likely to be very expensive. The Electric Power Research Institute (EPRI) estimates that energy from a conventional coal-fired power plant would cost 77 percent more with carbon capture and storage.[67] (See Figure 6.) As shown in the figure, pulverized coal plants would become much more expensive than gasified coal after rules requiring carbon capture and storage are implemented. (Because carbon sequestration is untested on a large scale, it could prove even more expensive than estimated by EPRI.)

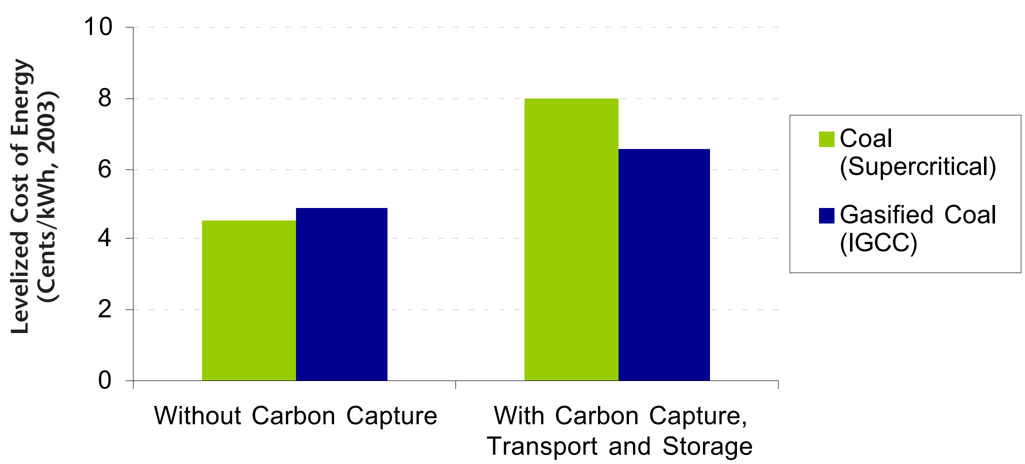
Depending on the regulatory scheme governing the particular company involved, these additional costs would be passed down tion of the two. Allocation of these costs could provoke significant battles. In the 1980s, state PUCs and consumer advocates fought heated battles with utilities over the allocation of costs for the construction of nuclear power plants, in some cases arguing that the decision to invest in nuclear power was "imprudent," and that the utilities should not be permitted to recover excess costs from ratepayers.[69]

Shareholders are unlikely to want to pay the additional costs either, and are beginning to demand that corporate directors consider their exposure to global warming-related risks. Shareholders of major companies filed 30 resolutions in 2005 requesting planning or action to reduce the risk of global warming.[70] And insurance companies have been considering reforms to reflect the risk, including denying liability coverage for directors and officers of companies sued for mismanagement over global warming.[71]

Municipal and cooperatively owned utilities face the same risk by choosing coal-fired power. In the event of a reduction in the value of their assets or an increase in costs caused by future climate regulation, these utilities would have to pass on costs to their members and ratepayers.

In addition, credit rating agencies may lower the bond ratings of companies that ignore the risk associated with future carbon

Figure 6: EPRI Estimated Cost of Carbon Capture and Sequestration[68]



Gambling on the Future

Some observers have suggested that energy companies are proposing large num bers of new coal facilities now in an attempt to have them permitted and approved before any new global warming pollution standards are implemented. The idea is that these plants would be "grandfathered" under any scheme of carbon regulation, much as many existing coal-fired power plants continue to be exempted from clean air laws.

The expectation of grandfathering has already factored into some utilities' decisions. For example, the energy company TXU hired consultants to prepare a report on future air pollution and climate change policies that concluded that reducing carbon dioxide emissions voluntarily would not be in TXU's interest.[73] The report asserted that a mandatory carbon cap-and-trade program could be set up with an initial allocation of emissions allowances based on recent emissions levels, suggesting that increased emissions now could yield increased allowances in the future.

Building new coal-fired power plants under the assumption that energy companies will be held harmless for those decisions under carbon regulation is a dangerous gamble, however.

First, there is no guarantee that a national carbon cap-and-trade program would allocate allowances to generators for free based on recent emissions. Indeed, the Northeast's Regional Greenhouse Gas Initiative (RGGI)—the first multi-state cap-and-trade program in the country—requires that at least 25 percent of pollution allowances be sold at auction, meaning that coal-fired power plant operators would need to pay for at least a portion of their allowances. Under RGGI, states also have the flexibility to require that a greater proportion of allowances be auctioned, rather than given away. The recent experience of emission trading programs in Europe, where dispensing free allowances has led to a massive financial windfall for generators at the expense of higher electricity prices for consumers, makes it even more unlikely that the U.S. would opt to follow a similar course.

Second, any serious effort to reduce global warming emissions in the U.S. will require significant reductions in emissions over the next several decades. The cost of carbon emissions is likely to rise over that period. Because coal-fired power plants are long-lived capital investments, power plant operators could find themselves paying more to operate their plants than initially expected.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There is a great deal of uncertainty regarding how carbon dioxide emissions will be regulated in the future. But companies that attempt to slip in "under the wire" with new coal-fired power plants before carbon regulation begins are gambling that the eventual rules will favor them—a gamble that may or may not turn out to be a winner.

regulation. With a lower bond rating, a company must pay higher interest rates in order to obtain a loan and would likely pass the increased cost of capital onto its customers.[72]

While the scope and stringency of future global warming regulations have yet to be decided, companies investing in coal-fired power plants know that carbon dioxide regulation is right around the corner. Investing in coal-fired power plants under the assumption that carbon dioxide will remain unregulated is imprudent, and is a recipe for future exposure to financial and regulatory risk.

Global Warming Liability

Companies that choose to build coal-fired power plants also potentially risk legal action for knowingly endangering public welfare.

The risk parallels the cases filed by states and the federal government against the tobacco industry over the last decade. The tobacco lawsuits sought to recover monies spent by Medicare on tobacco-related illnesses directly tied to cigarette companies' wrongful acts. In those lawsuits, lawyers for the public proved that the tobacco companies:[74]

- Withheld information about the harm caused by smoking and the addictiveness of nicotine;
- Made false and misleading statements about the health consequences of smoking;
- Attacked research finding that smoking causes health problems or that nicotine is addictive, despite knowing that the research was valid; and
- Failed to take reasonable steps to make their products safer.

The lawsuits were based on several legal foundations, including the Racketeer Influenced and Corrupt Organizations Act (RICO), which gives the federal government a right to obtain compensation for damages caused by conspiracies and enterprises to maximize profits through improper means.

To be sure, global warming is already imposing significant financial costs on governments and individuals across the U.S. Those costs will increase as governments grapple with:

- rising sea levels;
- the impact of more dangerous storms (and reduction in the willingness of private insurers to cover coastal properties);[75]
- damage to agriculture; and
- loss of freshwater supplies.

Some lawsuits have already been filed. In July 2004, eight states and New York City announced a lawsuit against the five largest electric utilities in the U.S. (in terms of annual emissions of global warming pollution). The suit named American Electric Power, Southern Company, Tennessee Valley Authority, Xcel Energy and Cinergy Corporation—together responsible for 650 million metric tons of carbon dioxide pollution annually, or about 11 percent of total U.S. emissions.[76]

The suit only sought to compel the companies to reduce their global warming pollution, not to recover any damages. In September 2005, a U.S. district court judge dismissed the suit, arguing that such important decisions were better left to Congress and the executive branch. The states are appealing the ruling in a higher court.[77]

Greenpeace, Friends of the Earth and several U.S. cities have filed a lawsuit under the National Environmental Policy Act, attempting to compel two U.S. lending agencies to consider the impact of global warming on the U.S. environment when making funding decisions. According to the plaintiffs, these agencies are funding $32 billion worth of fossil fuel projects using U.S. taxpayer money, making the threat of global warming more severe.[78] On August 23, 2005, a federal judge ruled that the lawsuit should proceed, despite a request by the U.S. government that the lawsuit be dismissed.[79] Should the lawsuit ultimately succeed, companies may find less money available to finance fossil-fuel related projects.

Future lawsuits are likely against companies responsible for global warming pollution on any number of legal grounds. It cannot be assumed that these lawsuits will fail, as the legal pitfalls faced by the tobacco industry (which was once considered virtually untouchable) demonstrate. Companies that fail to consider global warming in their plans for future sources of power generation potentially expose themselves and their shareholders to legal danger in the future.

Jay Thompson

Economic Risks of Increased Coal Demand

The economic risks of greater coal dependence are not limited to global warming. A dramatic increase in demand for coal could strain the nation's coal mining and transportation infrastructure, raise the price of energy and increase the risk of power shortages. As was the case for natural gas after the massive expansion of gas-fired electricity generation in the 1990s, this could make coal a less attractive energy source.

If built, all of the coal-fired power plants that are currently on the drawing board would require on the order of 380 million tons of coal per year.[80] As a result, demand for coal in the U.S. would increase by well over 30 percent.[81]

Delivering this coal to new power plants would likely require an expansion of the nation's rail infrastructure. The nation's railroads have already encountered difficulties in delivering coal to power plants over the past year. As a result, companies have had to cut back on power production at established coal-fired units (often the cheapest to operate), run natural-gas fired plants harder and longer for greater cost, and even purchase power at top prices on the open market—all to avoid running out of coal.[82]

For example, the Tennessee Valley Authority estimates it spent $80 million extra on fuel in 2005 (an increase of about 5 percent) because railroads were unable to deliver enough coal from Wyoming's Powder River Basin on time.[83] In March 2006, Ottertail cut the output of its Big Stone power plant in South Dakota by 25 percent after its coal stockpile fell to only a 10-day supply, forcing the company to purchase replacement power on the open market at higher costs.[84] The Arkansas Electric Cooperative Corporation began to burn more natural gas in May 2005 to make up for delayed rail shipments, raising its 2005 generation costs by 21 percent, or $100 million.[85] As a result, the average Arkansas family saw a $20 increase in its monthly electricity bill.[86]

Storms and derailments caused some of the recent problems with coal shipments. However, utility executives also allege that railroads have failed to keep up with demand. Michael Morris, the CEO of American Electric Power, told Congress in February 2006 that "by overpromising services, railroads have put the electric industry in a potential crisis situation this winter and next summer."[87] Making matters worse, the number of major freight carriers has consolidated from 40 to four since the deregulation of the railroads in 1980. These major companies have closed rail lines to trim costs, making the system more vulnerable to bottlenecks.[88]

The shortage of adequate shipping routes could become worse in the future, as the mining industry opens new mines in new locations to supply increased demand for coal (See discussion on page 26.)

Overall, the utility industry estimates that the cost of substituting more expensive fuels for the 20 million tons of coal from Wyoming tied up on the railroads has exceeded $3 billion.[89] The coal delays increased the demand—and the price—for natural gas, and thus the impact on consumers and the economy as a whole may be even higher.

Dramatically increasing demand for coal by building a fleet of new coal-fired power plants would only aggravate transportation challenges. Overcoming bottlenecks would require a large investment in transportation infrastructure, some of which could come from the public. Failure to adequately invest in transportation capacity during the "coal rush" could create availability and price volatility issues similar to those experienced in the U.S. over the last several years. (See Figure 7.)

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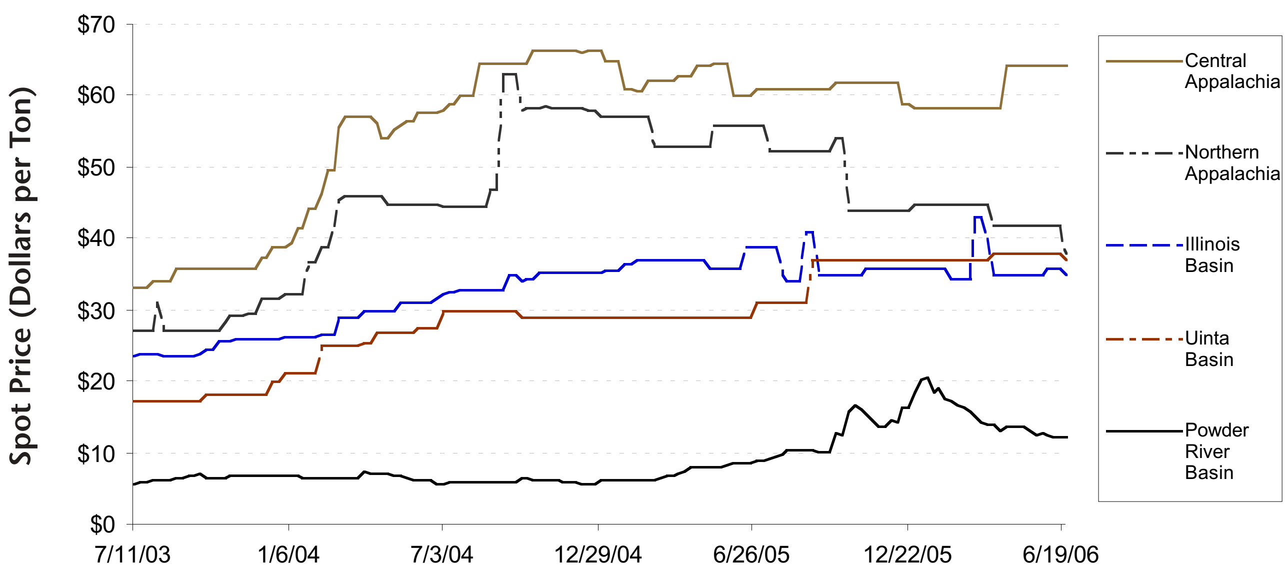
Figure 7: Coal Prices From Different U.S. Regions Over the Past Three Years[90]



Mining Damage to America's Land and Water

Mining additional coal would damage America's land and water resources.

Mining enough fuel to supply current and planned coal-fired power plants would require opening new mines. Currently producing coal mines in America report that they have around 18 billion tons of recoverable reserves, which would last less than 18 years at current consumption rates—and fewer years at higher rates of consumption.[91]

Overall, the Energy Information Administration estimates that the U.S. has enough coal resources to last for over 200 years at current rates of consumption (270 billion short tons).[92] About 120 billion tons are located close to the surface, and 150 billion tons are underground.

Over 75 percent of America's coal reserves are located in Montana, Wyoming, Illinois, West Virginia, Kentucky, Ohio and Pennsylvania. Accessing these coal reserves would involve building strip mines or underground caverns in places that currently supply clean water, areas for recreation, fields for growing food, or towns where people live. (See Figure 8.)

Coal mining causes a variety of serious and harmful impacts.

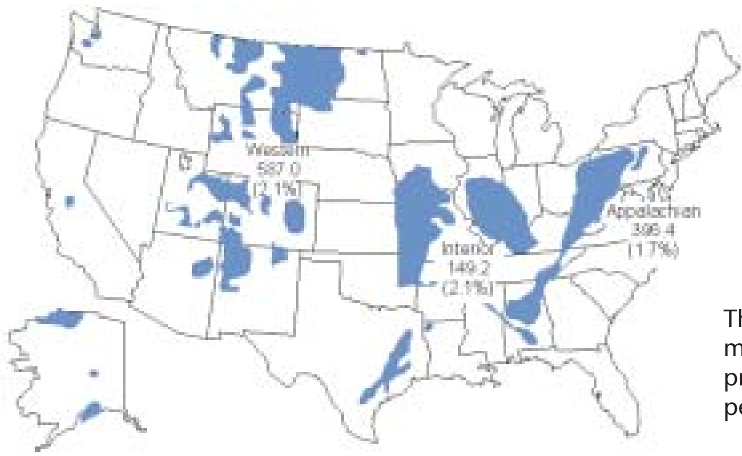
Coal mining contaminates water supplies. In 2004, coal mines reported the release of more than 13 million pounds of toxic chemicals to landfills or directly to streams, including emissions of ammonia, arsenic, chlorine, chromium and lead.[94] Coal-mining waste, acids and toxic metals can kill stream life and make water supplies undrinkable.

Water contamination also arises from wastes generated by the processing and combustion of coal. Across the country, coal ash and sludge is dumped into landfills and old mining pits, where it can leach toxic materials into the groundwater. Every year, coal-fired power plants in the U.S. generate 130 million tons of ash and sludge, containing toxic substances including chromium, arsenic and nickel. About half of these plants dump their waste in surface

V. Stockman

"Mountaintop removal" coal mining has leveled hillsides and polluted water supplies in Appalachia.

Figure 8: Location of Coal Deposits in the U.S.[93]



The numbers indicate million short tons of coal production in 2005, and percent increase from 2004.

ponds—only 26 percent of which are lined to prevent pollution from escaping.[95]

Coal mining also damages local landscapes. In Appalachia, a form of mining known as "mountaintop removal" has leveled many hills and filled valleys with the resulting debris. Between 1985 and 2001, mountaintop mining polluted or completely buried more than 1,200 miles of streams and destroyed 7 percent of the region's forests.[96] According to EPA analysis, if mountaintop mining continues unchecked, it will destroy more than 1.4 million acres of land—almost one tenth the area of West Virginia—and harm wildlife and disrupt dozens of communities.[97]

Underground "longwall" mining has triggered land subsidence that has undermined more than 5,000 homes, businesses and other properties and altered steams and wetlands.[98] Federal and state mining and mineral rights laws often leave surface property owners and nearby landowners with little recourse to protect their properties and quality of life.

No matter what kind of technology any new coal-fired power plants may use, "clean coal" or conventional, extracting the millions of tons of coal remaining in American soil would come at a high price.

More Health-Threatening Pollution

If all of the planned coal-fired power plants are built, they would increase annual pollution from power plants and other industrial facilities on the order of 1 to 3 percent.[99] These plants would directly emit an estimated:

- 120,000 tons per year of sulfur dioxide, a major ingredient in fine particle pollution, linked to premature death and respiratory and cardiovascular disease;
- 240,000 tons per year of nitrogen dioxide, a major ingredient in the photochemical smog that plagues many cities across the U.S. on summer days, triggering asthma attacks and sending people to the hospital; and
- 3 tons per year of mercury, a neurological toxicant that contaminates fish in rivers, lakes and the oceans.

Because new coal-fired power plants will have to meet modern air pollution standards under the federal Clean Air Act, air pollution from new coal-fired power plants will be improved compared to the oldest coal-fired plants. However, coal-fired power is still far from clean—especially compared to non-polluting energy sources including energy efficiency and wind power.

Adding to the pollution problem, increased coal freight shipments will create more diesel soot across the country.

Lost Opportunities for Clean Energy

The "coal rush" would consume investment dollars that could be used to promote cheaper and cleaner energy sources, including energy efficiency and renewable power.

In order to build all of the coal-fired power plants on the drawing board, electric utilities would have to invest $137 billion in capital costs. On top of this investment, utilities would have to spend over $100 billion to operate and maintain the plants, purchase fuel and build transmission lines to carry the power.[100] Future regulation of global warming pollution would create additional expenditures. In addition, the "coal rush" would also tend to drive billions of dollars in capital investment from other actors—for example, mining companies and railroads. Ultimately, this money will come out of the pockets of public taxpayers, ratepayers and investors.

Compact fluorescent lightbulbs are an example of a simple technology that can greatly reduce demand for electricity and the need for new power plants.

However, by investing in coal, America would lose a golden opportunity. If that same $137 billion in capital were instead invested in a balanced clean energy strategy including energy efficiency and renewable technologies like wind power, it could produce a similar amount of energy (or more), while creating practically zero global warming pollution, safeguarding the economy from risks associated with global warming, reducing mining impacts and greatly cutting health-threatening air pollution. In addition, investment in renewables and efficiency would generate jobs, renew communities, and help to stabilize energy prices.

Energy Efficiency

America has enormous potential to use energy more efficiently.

Reviewing a set of leading recent studies on achievable efficiency potential nationwide, the American Council for an Energy Efficient Economy concludes that the typical state could achieve energy savings of 24 percent below forecast levels within 20 years.[101] In other words, the typical state could halt growth in electricity demand with a well-designed efficiency program, and save money doing it.

Efficiency measures are two-thirds less expensive than generating and delivering electricity. In 2002, energy efficiency programs supported by public benefit funds in New England produced energy savings at an average lifetime cost of 2.4 cents per kWh.[102] Northeast Energy Efficiency Partnerships estimates that capturing all remaining achievable energy efficiency potential in New England would cost just 3.1 cents per kWh.[103]

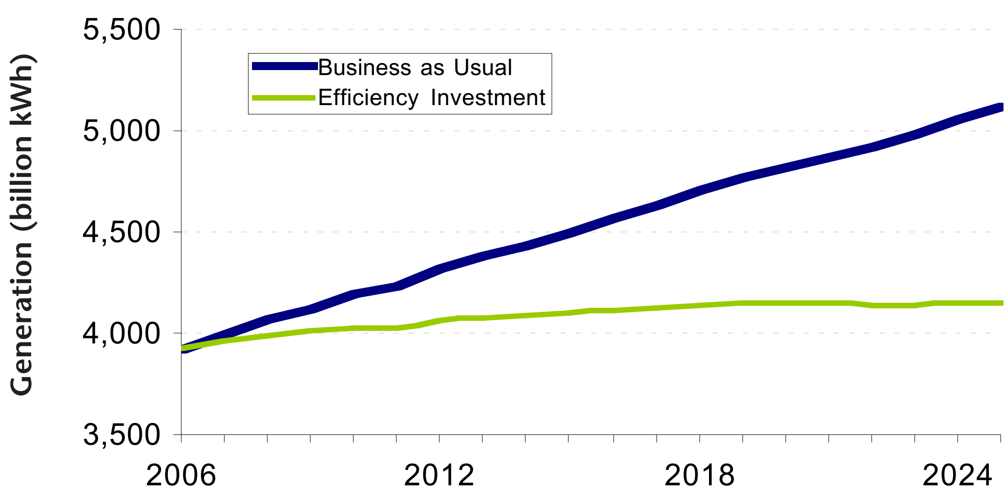
A recent estimate of energy efficiency potential in the Southwest (where energy efficiency measures have not penetrated as deeply as in the Northeast) concluded that six states from Arizona to Wyoming could reduce projected electricity demand by 33 percent by the year 2020 (or close to 100,000 GWh/year).[104] The benefits of this approach would include net savings on electricity and fuel of $28 billion and avoiding the need to build 34 power plants (500 MW). The study identified energy efficiency measures across all sectors of the economy that could result in lifetime electricity savings of 440 billion kWh at an average cost of $0.02 per kWh (2000 dollars). The study concluded that the benefits of the efficiency measures exceeded their costs by more than 400 percent.[105]

The six Southwestern states account for about 5 percent of the U.S. electricity market. Conservatively assuming that the U.S. as a whole only has half of the energy savings potential as these six states, extrapolating the findings of this study nationwide would mean that the U.S. has enough low-cost energy efficiency opportunities to reduce projected electricity demand by roughly 1 million GWh per year in 2025. This overall savings potential is likely an underestimate, especially because cost-effective but slightly more expensive efficiency measures could achieve even greater savings, and because a greater variety of measures will become both economic and achievable as fuel and electricity costs rise in the future.

With the conservative assumption that achieving efficiency savings at this scale across the U.S. would be more expensive than in the Southwest, costing 3 cents per kWh instead of 2 cents, a $137 billion investment could reduce U.S. electricity demand in 2025 by roughly 19 percent vs. business as usual, or about 1 million GWh.[106] (See Figure 9). And because energy efficiency is a distributed resource, it would help avoid the need to invest in power lines and distribution infrastructure.

In comparison, the proposed coal-fired power plants would produce about 670,000 GWh per year.[108] In other words, energy

Figure 9: Estimated Effect of a $137 Billion Investment in Energy Efficiency on U.S. Electricity Demand.[107]



efficiency measures could completely alleviate the need to build any new coal-fired power plants, or new transmission and distribution infrastructure—and do so for much less money.

Renewable Energy

America has similarly enormous potential to generate electricity from the wind, the sun, geothermal heat, energy crops, the ocean and many other clean and renewable resources.

The nation's cumulative wind power potential has been estimated at upwards of 10 trillion kilowatt-hours annually—more than twice the amount of electricity currently generated in the U.S.[109] The Great Plains has been dubbed the "Saudi Arabia" of wind for its vast, high quality wind resource. Similarly, the United States could generate all of its electricity using solar photovoltaics (PV) by installing solar panels on only 7 percent of the land area currently used for buildings, parking lots and other built-up areas.[110] Tapping solar thermal energy through "passive solar" applications, such as solar hot water heating, can significantly reduce use of fossil fuels in buildings. New central station solar power technologies promise the capability to use the sun's energy to generate electricity even when the sun isn't shining, by storing heat for use at night. And there is tremendous potential for energy from crops, tides, underground heat and other renewable sources.


NREL

The nation's cumulative wind power potential has been estimated at upwards of 10 trillion kilowatt-hours annually.

Wind

Until recently, the cost of renewable power has caused it to be rejected by utilities and regulators for most applications. Not any longer. In particularly windy areas of the country, wind power is already the cheapest electricity resource available.[111] For example, a recently constructed wind farm in Lamar, Colorado is producing electricity for less than 3.3 cents per kWh (with the benefit of the federal production tax credit).[112]

The Western Governors Association (WGA) estimates that from Texas to Washington state, potential wind resources could support 250,000 MW of wind turbines delivering electricity for an average cost below 6 cents per kWh, including transmission expenses but not distribution expenses or any tax credits.[113] The best sites for wind power in the region could support approximately 110,000 MW of wind turbines with an average cost of electricity of about 5.4 cents per kWh.[114]

In comparison, the U.S. Department of Energy estimates that in the next decade coal will have a levelized cost of about 5.3 cents per kWh, including capital, fuel, operation, maintenance and transmission costs.[115] This figure does not take into account the future cost of carbon regulations or the environmental and public health costs of coal combustion.

Replacing the output of all of the coal-fired power plants currently on the drawing board would require about 256,000

MW of wind.[116] The 18 western states alone have enough low cost wind resources to replace about 40 percent of the proposed coal-fired power projects. Developing these resources would require a capital investment of roughly $130 billion.[117] However, unlike coal, wind power has no ongoing fuel expenses, meaning that the capital investment is effectively purchasing a lifetime supply of fuel.

Expanding consideration of wind resources beyond just the western states, including the best sites for wind nationwide, on- or off-shore, greatly expands the amount of cost-effective wind resources that would be available and competitive now.

In the future, much greater amounts of wind resources will become available as wind turbine technology improves and the industry matures.[118] The research arm of the electric industry, the Electric Power Research Institute (EPRI), predicts that the average cost of wind power will drop 30 percent between 2010 and 2020, and by 2020, an average wind energy project without tax credits will be cheaper than any type of coal power plant with carbon storage, and cheaper than natural gas even if the cost of emitting carbon is $0.[119] A long-term federal production tax credit would more quickly enable much greater amounts of wind power across the country to become economically competitive with conventional coal, as would effective limits on global warming pollution.[120]

Solar Energy

Solar Photovoltaics

The economics of solar photovoltaic panels (PV) as a direct electricity generation source are not nearly as favorable as the economics of wind, but that is rapidly changing. As with wind power, the cost of solar PV has dropped dramatically in recent years—over the last two decades, the cost of solar panels has declined from about $20 per Watt to as low as $3.50 per Watt today.[121] (However, due to rapidly expanding demand, manufacturing capacities are strained and prices for silicon wafers have risen about 10 percent in the first half of 2006.[122] Further investment in silicon supply and manufacturing capacity will be required to expand the industry and eventually bring prices back down—as is happening in states that are actively expanding their solar markets.[123])

NREL

Solar PV roof tiles.

Moreover, residential and commercial PV provides unique economic value because of its status as a distributed resource—meaning that PV installations can reduce the need for additional investments in electricity transmission and distribution infrastructure. The city of Austin, Texas estimates that solar power is worth 10.4 to 11.7 cents per kWh when added to its system.[124]

Concentrating Solar Thermal Power

Concentrating solar thermal power is on the brink of commercial viability.

New designs for concentrating solar thermal plants show great promise. Solar power towers with thermal storage can store heat collected from sunlight during the day, to generate electricity during cloudy weather or even at night—an effective power source that is clean, sustainable and produces zero global warming pollution. Stirling dish solar systems are able to capture and transform the heat of the sun into electricity at very high efficiency. And solar trough systems have been refined to the point where companies are installing


NREL

Solar Two (left), *a power tower in the desert southwest, demonstrated the feasibility of storing heat from the sun to generate electricity at night. For over 10 years, parabolic solar trough power plants (right) have produced electricity for California.*


Stirling Energy Systems

Stirling solar dishes efficiently transform solar heat into electricity.

commercial facilities in the Nevada desert.

Solar power towers with thermal storage are one of the most flexible renewable energy technologies, with the ability to use captured heat to generate electricity even when the sun is not shining. In the late 1990s, Sandia National Laboratory in New Mexico demonstrated thermal storage technology on a power tower in the California desert. The plant stored solar energy in the form of molten salt, achieved an energy storage and recovery efficiency approaching 100 percent, and showed that solar power could cost-effectively serve electricity demand even at night.[125]

For almost two decades, 384 MW of solar trough plants have operated in the California desert. These plants do not have thermal storage, but instead rely on a small usage of natural gas to ensure that power is available on demand. These plants produce energy for around 12 cents per kWh, competitive in the peaking market, but not in the baseload market.[126]

New plants will be able to operate with little to no backup from natural gas and produce power for much less cost. With the installation of the first 1,000 to 3,000 MW of capacity, experts predict that experience and economies of scale will lower the cost of power from these facilities to as low as 5 cents per kWh—cheaper than coal-fired power with carbon storage, and competitive with conventional coal.[127]

Spain will be the site of the world's first commercial concentrating solar thermal power plant with thermal storage. Spanish policy offers a strong price premium to solar power, which is driving the installation of new technology and helping the industry to get off the ground.

In the U.S., Solargenix Energy is building a solar trough power plant in Boulder City, Nevada, scheduled for operation in early 2007, supported by Nevada's renewable energy standard.[128] Solargenix is considering the addition of thermal storage technology within the next few years.[129] Stirling Energy Systems plans to build two large Stirling solar dish power plants in the desert southwest to supply energy to California.[130] One 300 MW power plant, consisting of 12,000 Stirling dishes to be built in California's Imperial Valley, will supply energy to San Diego Gas and Electric. The other plant, a 500 MW facility with 20,000 Stirling dishes, will be built in the Mojave Desert near Los Angeles, supplying energy to Southern California Edison. The facilities will help the two utility companies meet California's renewable energy standard.

Solar thermal technology could rapidly increase in importance as a source of electricity in the U.S. The materials needed to produce a power plant are fairly commonplace, including glass, steel, salt, concrete and conventional steam turbines. Sandia National Laboratory estimates that a handful of companies implementing the technologies could install 20 GW of solar thermal capacity in the southwestern U.S. by 2020.[131]

Solar thermal technology currently has a capital cost of around $2.5 million per MW.[132] At this price, an investment of $137 billion would enable the construction of over 50 GW of solar thermal capacity. Because the capital cost of the facilities will decrease as the industry gains experience and benefits from economies of scale, such a large investment would likely yield much more than 50 GW. This level of installation is feasible: Nevada alone, excluding sensitive areas and land with a slope greater than 1 percent, has the potential for 1,700 GW of solar energy.[133]

Geothermal and Other Renewables

Geothermal energy is yet another area in which great potential exists. Already, geothermal is a major source of electricity in several U.S. states, including California, Nevada and Hawaii. Currently identified geothermal resources could provide as much as 25 to 50 gigawatts of additional capacity in the United States.[134]

A combination of wind, solar, tidal, biomass and geothermal resources—coupled with energy-saving renewable technologies such as passive solar heating and lighting, solar hot water heating and geothermal heat pumps—could provide a large and growing share of America's energy. A consistent emphasis on renewables in public policy and in research and development funding could bring many of these technologies into the mainstream.

Benefits of Efficiency and Renewables

Energy efficiency and renewable energy are economic and environmental winners—especially compared to coal.

Investing in energy efficiency would benefit consumers and the economy. First, individuals and businesses that implement energy efficiency see direct reductions in their energy costs over time. Second, all electricity consumers benefit from reduced costs to generate and supply power—particularly at peak periods when electricity is at high demand and is most costly to supply. Finally, all consumers benefit from reduced demand for fossil fuels.

Moreover, energy efficiency improvements benefit local economies. By reducing energy costs, efficiency measures free up money that consumers can then use on other goods and services. And consumer spending on energy efficient products tends to benefit local merchants and efficiency service providers, as opposed to spending on fossil fuels, which tends to siphon consumer dollars outside of the region.

Wind energy has potential advantages for spurring rural economic redevelopment. The U.S. Department of Energy estimates that producing about 5 percent of the nation's power from wind by 2020 would create $60 billion in capital investment in rural America by 2020, provide $1.2 billion in new income for farmers and rural landowners, and create 80,000 new jobs. This new source of income—which could amount to as much as $14,000 per year for the owner of a 250-acre farm—could make the difference between insolvency and survival for many remaining family farmers, and the property tax revenues from the installations could provide a new source of income for struggling rural communities.[135]

Investments in renewable energy sources also support American businesses that manufacture renewable energy components. Despite the ground lost by American renewable energy manufacturers over the past decade, significant manufacturing infrastructure remains. Creating a homegrown market for renewable energy technologies could ensure that these manufacturers remain and grow in the United States. For example, a startup company called Nanosolar recently announced plans to build the world's largest thin film solar panel manufacturing facility in California, after California established a $3.2 billion Million Solar Roofs incentive program.[136]

One 2005 study estimates that a clean energy strategy, coupled with a shifting of federal energy subsidies to renewables and efficiency, could create as many as 154,000 new jobs in the United States and increase net wages by $6.8 billion.[137] The Union of Concerned Scientists estimates that a 20 percent national renewable energy standard for electricity generation would create twice as many new jobs as meeting demand growth with fossil fuels, while adding $10.2 billion to the nation's gross domestic product.[138]

However, if America stakes its energy future on coal, the opportunity to realize these benefits will be lost.

A Better Alternative

America is at a critical turning point. The current energy crossroads—uncertain supplies of fossil fuels and rising prices—has the country perched on a precipice that leads toward increased dependence on coal. Committing to that course would seriously harm the future of America, and of the world.

However, states and the federal government have an opportunity to stop the "coal rush" and move toward a clean energy future. An America that uses no more energy than it does today—and that relies on renewable sources for a large and growing share of that energy—is not a fantasy. It is a realistic, perhaps even conservative, goal that can be achieved using technologies and policy tools existing today.

Achieving that goal will leave America cleaner, safer, more secure and more prosperous in the years to come. But it is only a beginning: the imperatives of global warming alone demand that we reduce our consumption of fossil fuels even further within the foreseeable future. By increasing energy efficiency, ramping up the deployment of renewable power, and continuing with research and development of the next generation of energy technologies, America will be in a better position to meet the challenges of the future.

To stop the "coal rush," citizens and government should work to:

Limit Global Warming and Health-Threatening Pollution from Power Plants

The states and the federal government should impose strong caps on global warming pollution from power plants at a level that is sufficient to minimize human interference with the global climate.

Establishing a limit on carbon dioxide pollution from power plants can create a powerful disincentive to the construction of new coal-fired power plants and the continued operation of old, inefficient coal-fired generation, hastening its replacement with cleaner and more efficient sources of electricity.

For example, seven states in New England and the Mid-Atlantic created the Regional Greenhouse Gas Initiative (RGGI) in 2005, which will require reducing power plant carbon dioxide emissions by 10 percent by 2019. The program caps regional carbon dioxide pollution from electricity generation and sets up a trading mechanism to achieve the required emissions reductions in an economically efficient way.[139] Another option would be to require long-term utility contracts to carry global warming performance standards, limiting the amount of carbon dioxide emissions per unit of electricity.

Simply capping pollution will not be enough—global warming pollution levels must be dramatically reduced in order to prevent the worst impacts of climate change. States can set targets and create mechanisms to ratchet down allowable pollution levels, offering signals to utility companies that will help guide their investments in new technologies.

For example, in June 2005 Governor Schwarzenegger of California issued an executive order establishing a target of reducing global warming pollution to 80 percent below 1990 levels by the year 2050.[140] Governor Bill Richardson of New Mexico issued an executive order shortly thereafter setting similar global warming pollution reduction targets, including 10 percent below 2000 levels by 2020 and 75 percent below by 2050.[141] Scientists estimate that globally, industrialized countries will need to cut pollution on this scale to avoid the worst impacts of global warming.

Prevent the Construction of Any New Coal-Fired Power Plants

States and the federal government should not allow any new coal facility to be built unless it meets strict conditions consistent with both climate stabilization goals and the financial interests of electricity consumers.

For example, the Idaho Legislature set a two-year moratorium on coal-fired power plants in the state after Sempra Energy proposed to construct a coal-fired power plant in Jerome County.[142] The moratorium states that "coal-fired power plants may have a significant negative impact upon the health, safety and welfare of the population, the quality and financial security of existing agricultural businesses and industries, economic growth of the state of Idaho, and the environmental quality and natural resources of this state," and that the moratorium will offer time to study these issues.[143]

States and the federal government should establish their own moratoriums, and set them for the long term. Moratoriums should be lifted only if it can be demonstrated that a coal-fired technology (such as gasified coal with carbon storage) is the least-cost way to reduce global warming pollution consistent with climate stabilization goals, and that carbon storage is feasible and permanent.

Price Coal Fairly

Government leaders and utility regulators should ensure that *all* the costs of coal-fired power plants—including the societal cost of global warming and the probable cost of additional pollution control requirements—are fully considered when utility investment decisions are made.

Even though the costs to society of global warming and of soot, smog and mercury pollution cannot be precisely determined, they are demonstrably greater than zero. Similarly, the exact costs utilities will face because of future limits on carbon dioxide pollution cannot be known—but they can be estimated. Proceeding as if these costs were zero leads to imprudent and irresponsible decisions. Investment decisions can also have external benefits in addition to costs, and these also deserve consideration in the regulatory process.

To price coal fairly:

- Regulators and political leaders should explicitly consider the costs of pollution and future regulation when making decisions on the construction of new power plants.

- Other clean resources that could satisfy or reduce energy demand, such as renewable energy and energy efficiency, should be explicitly considered as alternatives.
- When comparing coal to alternatives, decision-makers should consider the external benefits of efficiency measures and renewable power, including economic growth, improved public health and minimized environmental impact.

Regulators Should Not Give Undue Preference to Coal Gasification Technology

Regulators should not saddle ratepayers with the additional costs of coal gasification power plants and carbon storage when cleaner, more sustainable options exist. Gasified coal technology should not be pushed to the front of the line ahead of better alternatives, and should be approved only if:

- Gasified coal and carbon storage are proven to be less expensive than other clean resources that could satisfy or reduce energy demand, such as renewable energy and energy efficiency; and
- New gasified coal plants with carbon storage are used to replace old, inefficient coal-fired power plants, not augment them.

Eliminate Subsidies for Coal and Other Fossil Fuels

Between 1950 and 1997, the coal industry received more than $70 billion in federal subsidies, or nearly $1.5 billion per year.[144] In the Energy Policy Act of 2005, Congress approved an additional $7.8 billion for coal. These subsidies included several billion for a "clean coal" research and development program that has been criticized by the Government Accountability Office for mismanaging taxpayer money.[145]

As a whole, fossil fuels such as coal, oil, and gas received more than $420 billion in federal subsidies between 1950 and 1997.[146] These subsidies distort the playing field and make it harder for emerging renewable technologies to compete.

Lavishing additional money on the coal industry, or other carbon-intensive industries, is a poor use of public funds. Government at all levels should ensure that no public money goes to support the extraction or use of coal or other fossil fuels.

Prioritize Cleaner and Safer Alternatives, Including Efficiency and Renewable Energy

Leaders at all levels of government should take aggressive action to encourage the development of cleaner alternatives to coal-fired power plants, particularly measures to improve energy efficiency and encourage the development of clean renewable resources. These measures should include:

- **Creating or improving energy efficiency programs.**
  Despite the fact that energy efficiency measures are cheaper than increasing electricity supply, they can't compete with new power plants on equal footing. Market barriers (including lack of consumer awareness, the up-front cost of efficient technologies, and split incentives between builders and buyers) block the full penetration of efficiency measures. Effective efficiency programs can overcome these

market barriers and realize energy savings at low cost. Programs should have a dedicated funding source adequate to realize achievable energy savings, with a minimum goal of ending growth in electricity consumption by the end of the decade.

- **Reform utility rate structures.**
  Utility rate structures in many states continue to tie utility profits to sales of energy—acting as a disincentive to cost-effective energy efficiency improvements. In addition, both deregulated electricity markets and regulatory practices in many states fail to treat energy efficiency on a par with new power plants and transmission infrastructure as a solution to electricity supply problems. To correct this situation, states can:
  - Decouple utility profits from energy sales through the use of per-customer revenue caps;
  - Require that energy efficiency be considered as an alternative to new power plant construction (California, for example, requires utilities doing long-range planning for power procurement to secure their needs through efficiency first, renewables second and fossil fuels last); [147] and
  - Require that demand side management (including efficiency improvements) be considered as an alternative approach to new transmission line construction in grid-constrained areas.
- **Establish appliance efficiency standards.**
  States have latitude to impose energy efficiency standards for residential and commercial appliances where the federal government has failed to do so. States may also petition the federal government for a waiver to implement stronger energy efficiency standards for appliances subject to federal regulation. At least 15 residential and commercial appliances—ranging from commercial boilers to DVD players—are potential targets for immediate adoption of efficiency standards.[148]
- **Upgrade building codes.**
  State building codes regulate the construction of residential and commercial buildings and generally include standards to ensure minimum levels of energy efficiency. Most states have adopted some variation of international building energy codes for residential and/or commercial buildings, but in many states codes are either outdated or are not well enforced. States should move to adopt the most recent version of international building energy codes and work with enforcement officials to ensure that the codes are properly implemented in new construction.
- **Create renewable energy standards.**
  Renewable energy standards (RES) require that a certain percentage of the electricity supplied to consumers in a given state come from renewable resources. States vary greatly in their renewable energy potential, so there is no one-size-fits-all target for the amount of renewable energy states can reasonably require. But an increase in renewable power generation of 1 percent per year is a realistic goal for most states.

  The percentage of renewable energy required is not the only important decision that must be made in designing an RES. Important as well is the definition of what is "renewable" and what is not. A few state RESs have allowed polluting fuels such as municipal solid waste and coal waste to receive credit as "renewable" sources of energy. An effective RES sets high standards for renewable energy generation, targeting truly clean and renewable sources of energy such as wind, solar, geothermal, landfill methane and clean biomass.

Another option to achieve the same goal would be a "feed-in" law, guaranteeing a specific purchase price for a specific type of renewable energy. For example, Spain offers a premium for concentrated solar thermal power. The guaranteed price stimulates growth in the industry, helping to lower prices and speeding the pace at which the technology will penetrate the market and reach full economic competitiveness.

- **Create renewable energy funds.** Dedicated funds to support the development of renewable energy can play a key role in encouraging the development and market introduction of new forms of renewable energy. For example, California recently established a $3.2 billion energy fund to support residential solar power. Renewable energy funds in other states have supported pilot projects to demonstrate new renewable technologies such as tidal power.

  Many state renewable energy funds are financed through small surcharges on electricity bills. Extending these surcharges to cover natural gas and oil users, and protecting renewable energy funds from legislative funding raids would ensure that these programs have the stable resources they need to develop long-term programs to support renewable energy.

Appendix A: Global Warming Impacts by State

State	Number of Proposed Plants	Total Capacity (MW)	Carbon Dioxide Emissions of New Plants (MMT)	2003 Carbon Dioxide Emissions (MMT)	Percent Increase in State $C0_2$ Emissions
TX	17	12,403	77.1	255.7	30%
IL	14	10,338	62.4	100.3	62%
NV	7	6,015	36.8	25.3	145%
KY	8	4,946	30.2	87.3	35%
FL	6	4,355	26.3	130.1	20%
OH	7	4,310	26.0	123.1	21%
Undecided	4	3,500	21.7	-	-
PA	7	3,151	19.5	121.6	16%
WA	2	3,100	19.0	15.0	126%
CA	1	2,500	15.5	60.7	26%
MT	6	2,329	14.6	19.1	76%
WI	4	2,400	14.4	49.4	29%
KS	2	2,150	13.3	37.3	36%
SC	2	2,080	12.9	39.4	33%
UT	3	2,070	12.9	35.2	37%
WV	5	2,095	12.7	82.2	16%
IA	3	1,940	11.7	40.0	29%
NM	2	1,800	11.2	30.9	36%
CO	4	1,789	10.8	39.6	27%
IN	3	1,730	10.2	118.9	9%
VA	2	1,600	9.9	46.8	21%
LA	3	1,605	9.8	58.1	17%
OK	2	1,600	9.7	46.6	21%
AZ	3	1,400	8.4	50.6	17%
MN	3	1,331	8.0	37.6	21%
GA	1	1,200	7.5	81.5	9%
WY	6	1,159	7.1	45.5	16%
MO	3	1,125	7.0	75.9	9%
ID	2	1,100	6.4	1.3	492%
TN	1	1,000	6.2	58.5	11%
NE	2	880	5.5	20.7	26%
NC	1	800	5.0	72.6	7%
NY	2	792	4.6	57.6	8%
CT	1	752	4.3	10.3	42%
DE	1	752	4.3	6.5	66%
ND	2	675	4.3	30.4	14%
AR	1	665	4.1	27.1	15%
AK	3	650	3.9	4.7	82%
SD	1	600	3.5	3.8	91%
OR	1	600	3.5	9.1	38%
MS	1	440	2.7	25.3	11%
MI	1	425	2.6	77.2	3%
MD	1	180	1.1	31.8	4%

Appendix B: Lost Opportunity Costs by State

State	Number of Proposed Coal-Fired Plants	Total Capacity (MW)	Lost Opportunity Cost (Capital Cost of New Plants, $Million)
TX	17	12,403	$15,140
IL	14	10,338	$14,025
NV	7	6,015	$10,165
FL	6	4,355	$7,000
KY	8	4,946	$6,357
OH	7	4,310	$5,255
WY	6	1,159	$4,759
Undecided	4	3,500	$4,700
PA	7	3,151	$4,437
WI	4	2,400	$4,000
WA	2	3,100	$3,500
KS	2	2,150	$3,350
WV	5	2,095	$3,055
MT	6	2,329	$3,035
IA	3	1,940	$2,900
UT	3	2,070	$2,850
VA	2	1,600	$2,600
MO	3	1,125	$2,550
CA	1	2,500	$2,500
IN	3	1,730	$2,500
NM	2	1,800	$2,500
CO	4	1,789	$2,467
SC	2	2,080	$2,400
LA	3	1,605	$2,350
AZ	3	1,400	$2,339
MN	3	1,331	$2,300
OK	2	1,600	$1,900
ID	2	1,100	$1,850
GA	1	1,200	$1,400
NE	2	880	$1,295
NY	2	792	$1,290
CT	1	752	$1,250
DE	1	752	$1,250
ND	2	675	$1,100
OR	1	600	$1,100
AK	3	650	$1,071
AR	1	665	$1,000
SD	1	600	$1,000
TN	1	1,000	$1,000
NC	1	800	$800
MS	1	440	$500
MI	1	425	$425
MD	1	180	$180

Appendix C: List of Proposed Coal-Fired Power Plants[149]

Sponsor	Location	Size (MW)
Nuvista	Alaska, Bethel	100
Usibelli Coal Mine Inc.	Alaska, Healy	200
Agrium US	Alaska, Kenai	350
Tucson Electric Power	Arizona, Springerville	400
Tucson Electric Power	Arizona, Springerville	400
Southwestern Power Group	Arizona, Bowie	600
LS Power Development	Arkansas, Osceola	665
Fernald Power	California, Humbolt City	2,500
Radar Acquisitions Corp. / Kiewit	Colorado	400 - 500
Tri-State Generation and Transmission	Colorado, Front Range	600
Lamar Light & Power & Ark. River Power Auth.	Colorado, Lamar	39
Xcel Energy	Colorado, Pueblo	750
NRG Energy	Connecticut, Montville	752
NRG Energy	Delaware, Indian River	752
Jacksonville Electric	Florida, Duval	600
Orlando Utilities Comm. & U.S. DOE	Florida, Orange County	285
Seminole Electric Cooperative	Florida, Putnam County	750
Florida Mun. Power Agency, City of Tallahassee, JEA and Reedy Creek Improvement District	Florida, Taylor County	800
Gainesville Regional Utilities	Florida	220
Florida Power & Light	Florida, TBA	1,700
Longleaf Energy (LS Power Development)	Georgia, Early County	1,200
Sempra Energy Resources	Idaho, Elmore or Jerome	600
Southeast Idaho Energy LLC	Idaho, Pocatello	500
Dynegy	Illinois, Baldwin	1,300
Illinois Energy Group	Illinois, Benton	1,500
Corn Belt Energy	Illinois, Elkhart	91
Turris Coal Company	Illinois, Elkhart	25-35
Indeck Energy Service	Illinois, Elwood	600
Clean Coal Power Resources	Illinois, Fayette County	2,400
EnviroPower	Illinois, Franklin County	500
Madison Power Corp.	Illinois, Marion	500
Southern Illinois Power	Illinois, Marion	120
City Water, Light & Power	Illinois, Springfield	200
Erora Group	Illinois, Taylorville	777
Peabody Energy / Prairie State Energy Campus	Illinois, Washington City	1,500
United Supply of America	Illinois, White County	270
Steelhead Energy Company LLC	Illinois, Williamson County	545
Cinergy Corp.	Indiana, Edwardsport	600
Tondu Corp,	Indiana, St. Joseph County	630
EnviroPower	Indiana, Sullivan County	500
MidAmerican Energy	Iowa, Council Bluffs	790
Dairyland Power Cooperative	Iowa, Mitchell or Chickasaw	400
LS Power	Iowa, Waterloo	750
Sunflower Electric Power Corp. and Tri-State Generation and Transmission	Kansas, Garden City (Holcomb)	1,300
Great Plains Energy	Kansas	850

Technology	Timing	Investment ($ Million)	Change from Original DOE List
Conventional	Proposed (3/2004), In Service - 2010	$100	
Conventional	Proposed (5/2003), In Service - TBD	$421	
IGCC	Feasibility study (12/2005), In Service - 2011	TBD	
Conventional	Construction (11/2005), In Service - 2006	$939	
Conventional	Proposed (11/2005), In Service - 2009	$400	
IGCC	Proposed 6/2006	$1,000	Addition
Conventional	Construction (3/2006), In Service - 2010	$1,000	
Conventional	Proposed (10/2001), In Service - TBD	$2,500	
Conventional	Feasibility Study (10/2003), In Service - TBD	$500	
Conventional	Proposed (10/2004), In Service - 2020	$600 (est.)	Reduced Size, Increased Timing
Conventional	Feasibility study (8/2004), In Service - TBD	$67	
Supercritical	Broke ground (12/2005), In Service - 2009	$1,300	
IGCC	Proposed (6/2006), In Service - 2011/12	$1250 (est.)	Addition
IGCC	Proposed (6/2006), In Service - 2011/12	$1250 (est.)	Addition
CFB	Operational (7/2002), In Service - 2002	$600	
IGCC	Proposed (12/2005), In Service - 2010	$750	
Conventional	Permiting (3/2006), In Service - 2012	$1,200	
Supercritical	Developing (10/2005), In Service - 2012	$1,500	
CFB	Proposed (2004), In Service - 2011	$550	Addition
Supercritical or IGCC	A Supercritical plant proposed for St. Lucie County was rejected by the County Commission in Nov. 2005. The utility is now considering alternate locations and potentially IGCC technology.[150]	$2,400 (est.)	Addition
Conventional	Permitting (11/2004), In Service - 2005	$1,400	
Supercritical	Selling to New Owner (4/2006)[151]	$1,000	Now Selling to New Owner
IGCC	Proposed (3/2005), In Service - 2010	$850	
Conventional	Proposed (10/2001), In Service - 2007	$1,500	
Conventional	Proposed (8/2002), In Service - TBD	$1,700	
Supercritical	Development (6/2005), In Service - TBD	$140	
Conventional	Proposed (10/2001), In Service - TBD	$35	
CFB	On Hold (11/2005), In Service - 2007	$1,000	
Fuels Gasification	Proposal (10/2002), In Service - TBD	$2,800	
Conventional	Permitting (5/2003), In Service - 2007	$500	
IGCC	Proposal (6/2005), In Service - TBD	$2,000	
Conventional	Operational (6/2003), In Service - 2003	$50	
Conventional	Development (9/2005), In Service - 2010	$200	
IGCC Coproduction	Development (1/2006), In Service - 2010	$1,100	
Conventional	In Permitting (2/2006), In Service - 2008	$2,000	
CFB	Proposal (10/2005), In Service - TBD	$400	
IGCC	Proposal (6/2005), In Service - TBD	$600	
IGCC	Proposal (9/2005), In Service - TBD	$900	
IGCC	Considering (9/2005), In Service - TBD	$1,000	
Conventional	Permitting (10/2002), In Service - TBD	$600	
Supercritical	Construction (8/2004), In Service - 2007	$1,200	
Conventional	On Hold (12/2004), In Service - 2009-2014	$400	
Conventional	Proposal (2/2006), In Service - 2011	$1,300	
Conventional	Near Construct. (7/2005), In Service - 2013	$2,500	Size Increased
Conventional	On Hold (7/2004), In Service - TBD	$850	

Sponsor	Location	Size (MW)
EnviroPower	Kentucky, Calvert City	500
Peabody Energy/ Thoroughbred Campus	Kentucky, Muhlenberg	1,500
Estill County Energy Partners	Kentucky, Estill County	110
Cash Creek Generation	Kentucky, Henderson City	1,000
East Kentucky Power co-op	Kentucky, Maysville	268
East Kentucky Power co-op	Kentucky, Maysville	278
Global - Kentucky Pioneer Energy - DOE	Kentucky, Clark County	540
LG&EPowergen	Kentucky, Trimble County	750
Cleco Power	Louisiana, Boyce	600
NRG Energy	Louisiana, New Roads	775
NRG Energy	Louisiana, New Roads	230 (Repowering)
AES Corporation	Maryland, Cumberland	180
Manistee SaltworkTondu Corp.	Michigan, Manistee	425
Great River Energy	Minnesota, Dakota County	250-500
Excelsior EnergyMesaba Energy Project	Minnesota, Itasca County	531
Xcel Energy / LS Power	Minnesota, Rosemount	550
Tractebel Power	Mississippi, Choctaw County	440
Associated Electric Cooperative Inc.	Missouri, Carroll County	TBD
Springfield City Council	Missouri, Springfield	275 (Additional)
Great Plains Energy Kansas City Power & Light	Missouri, Weston	850
Bull Mountain Development	Montana, Billings	700
Southern Montana Electric Gen & Trans	Montana, Great Falls	250
Centennial Power	Montana, Hardin	116
Great Northern Power Development / Kiewit	Montana, Miles City	500
Thompson River Co-Gen LLC	Montana, Thompson River	13
Bechtel / Kennecott Energy	Montana, Undetermined	750 (Phase I)
Hastings Utilities, Grand Island	Nebraska, Hastings	220
Omaha Public Power District	Nebraska, Nebraska City	660
Sierra Pacific Resources	Nevada	1,500
Sempra Granite Fox Power	Nevada, Gerlach	1,450
Newmont Mining Corp.	Nevada, Elko	200
Barrick Gold	Nevada, East of Reno	115
Sithe Global Power	Nevada, Mesquite	750
LS Power Associates White Pine Energy	Nevada, White Pine County	500 (out of a possible 1,600)
Sierra Pacific	Nevada, White Pine County	1,500
Sithe Global Power	New Mexico, Desert Rock	1,500
Peabody Energy / Mustang Energy	New Mexico, Milan	300
Jamestown Board of Public Utilities	New York, Jamestown	40
NRG Energy	New York, Huntley	752
Duke Power	North Carolina, Cliffside	800
Montana Dakota Utility Westmoreland Power	North Dakota, Gascoyne	175
South Heart Coal	North Dakota, Stark County	500
Nordic Energy	Ohio, Ashtabula	830
Dominion Energy	Ohio, Conneaut	600
CME International	Ohio, Hanging Rock	600
American Municipal Power-Ohio	Ohio, Letart	1,000
Global Energy	Ohio, Lima	600
American Electric Power	Ohio, Meigs County	600
Sunoco	Ohio, Scioto County	80
SynFuel	Oklahoma, Enid	600
LS Power Development	Oklahoma, Sequoyah	1,000
Summit Power Group	Oregon, Clatskanie	600
River Hill Power LLC	Pennsylvania, Clearfield County	290

Technology	Timing	Investment ($ Million)	Change from Original DOE List
Conventional	Development (8/2002), In Service - TBD	$600	
Conventional	Permitting (8/2005), In Service - 2007	$2,100	
CFB	Development (10/2004), In Service - 2008	$150	
Conventional	Permitting (11/2001), In Service - 2006	$1,000	
CFB	Operational (3/2005), In Service - 2005	$367	
CFB	Proposed (11/2004), In Service - 2009	$400	
IGCC	Delayed (6/2004), In Service - 2004	$540	
Supercritical	Approved (3/2006), In Service - 2010	$1,200	
CFB	Development (2/2006), In Service - 2009	$1,000	
Supercritical	Permitting (8/2005), In Service - TBD	$1,000	Size Increased
CFB	Proposed 2006	$350 (est.)	Addition
CFB	Operational, In Service - 2000	$180	
Conventional	On Hold (11/2004), In Service - 2006	$425	
IGCC or CFBC	Proposed (2/2002), In Service - 2008	$500	
IGCC	Permitting (9/2005), In Service - 2010	$1,200	
Conventional	Preliminary (3/2003), In Service - TBD	$600	
Conventional	Operational, In Service - 2002	$500	
TBD	Proposed (4/2005), In Service - TBD	$1,000	
Conventional	Voters Reject (10/2004), In Service - 2007	$250	
Conventional	Near Construct. (1/2006), In Service - 2011	$1,300	
Conventional	Air Permit Expired (7/2005), In Service - TBD	$700	
CFB	Proposed (2/2006), In Service - 2010	$515	
Conventional	Construction (8/2004), In Service - 2005	$150	
CFB	Proposal (8/2004), In Service - 2008	$900	
Conventional	Operational (11/2005), In Service - 2005	$20	
Conventional	Proposal (10/2003), In Service - 2010	$750	
Conventional	Board Approved (12/2004), In Service - 2012	$445	
Conventional	Construction (12/2005), In Service - 2009	$850	
Conventional	Feasibility Study (11/2003), In Service - 2010	$3,000	Size Increased
Supercritical	Selling to New Owner (4/2006)[152]	$2,000	Now Selling to New Owner
Conventional	Near Construction (3/2006), In Service - 2008	$450	
Conventional	Considering (7/2004), In Service - TBD	$115	
Conventional	Proposal (2/2006), In Service - 2011	$1,000	
Conventional	Developing (11/2005, In Service - 2010	$600 - $1000	
Conventional	Proposal (2/2006), In Service - 2011, 2014	$3,000 (w/ transmission line)	
Conventional	Proposal (1/2006), In Service - 2010	$2,000	
Conventional	Permitting Stage (11/2005), In Service - 2006	$500	
CFB	Proposal (4/2005), In Service - 2008	$40	
IGCC	Proposed (6/2006), In Service - 2013/14	$1250 (est.)	Addition
Conventional	Proposal (5/2005), In Service - 2010	$800	
Conventional	Permitting (6/2005), In Service - 2010	$300	
CFB	Proposed (8/2005), In Service - 2008	$800	
Cogeneration	Permitting (5/2004), In Service - 2006	$1,200	
Conventional	Considering (7/2004), In Service - 2010	$600	
IGCC	Considering (11/2005), In Service - TBD	$600	
Conventional	Proposal (11/2005), In Service - 2012	$1,200	
IGCC	Near Construction (12/2005), In Service - 2008	$575	
IGCC	Proposed (3/2006), In Service - 2010	$1,000	
Cogeneration	Proposed (9/2004), In Service - 2006	$80	
Fuels Gasification	Initiate - 2001, In Service - 2008	$900	
Conventional	On Hold (8/2002), In Service - TBD	$1,000	
IGCC	Proposed (2/2006)	$1,100	Addition
CFB Cogeneration	Proposal (8/2005), In Service - 2008	$300	

Sponsor	Location	Size (MW)
Wellington Development	Pennsylvania, Greene County	525
Reliant Energy	Pennsylvania, Indiana	520
Waste Management and Processors Inc	Pennsylvania, Schuykill County	41
EnviroPower	Pennsylvania, Somerset	525
PA Energy Development Corp.	Pennsylvania, Southwestern region	1,000
Robinson Power CO.	Pennsylvania, Washington County	250
Santee Cooper	South Carolina, Berkeley County	1,280
LS Power Development	South Carolina, Marion City	500-1,100
Otter Tail Power Company	South Dakota, Milbank	600
CME North America Merchant Energy	Tennessee, Chattanooga	1,000
Sempra Generation	Texas, Bremond	600
City Public Service Board of San Antonio	Texas, Calaveras Lake	750
LS Power Development	Texas, Riesel	800
TXU	Texas, Robertson County	1,720
TXU	Texas, Milam	630
TXU	Texas, Freestone	800
TXU	Texas, McLennan	800
TXU	Texas, McLennan	800
TXU	Texas, McLennan	800
TXU	Texas, Rusk	800
TXU	Texas, Titus	800
TXU	Texas, Mitchell	800
TXU	Texas, Fannin	800
Formosa Plastics	Texas, Point Comfort	300
NuCoastal Power	Texas, Point Comfort	303
NRG Energy	Texas, Limestone	800
NRG Energy	Texas, Limestone	100 (Uprate)
PacifiCorp	Utah, Emery	850
Intermountain Power	Utah, Delta	950
Nevco Energy	Utah, Sigurd	270
LS Power Development	Virginia, Sussex County	1,600
Dominion, AEP, Appalachian Power	Virginia, Southwest	TBD
Composite Power	Washington, Richland	2,500
Energy Northwest	Washington, Kalama	600
GenPower LLC Longview	West Virginia, Monogalia County	660
Western Greenbrier CO-Generation / DOE	West Virginia, Greenbrier County	85
Appalachian Power (American Electric Power)	West Virginia, Mason County	600
North American Power Group Ltd.	West Virginia, Not yet located	300
Anker Energy	West Virginia, Upshur County	450
Alliant Energy	Wisconsin, Portage	500
MidAmerican Energy	Wisconsin, Cassville	200
Wisconsin Energy &Madison Gas	Wisconsin, Oak Creek	1,200
Wisconsin Public Service Corp.	Wisconsin, Wausau	500
North American PowerGroup	Wyoming, Campbell County	300
Basin Electric Power Cooperative	Wyoming, Gillette	375
Black Hills Corp.	Wyoming, Gillette	90
Black Hills Corp.	Wyoming, Gillette	90
Rentech	Wyoming, Gillette	104
DKRW	Wyoming, Medicine Bow	200
Xcel Energy	Undecided, WI, SD, or MN	750
FirstEnergy/Consol	Undecided, PA or OH	TBD
Westar Energy Inc.	Undecided	TBD
Dominion Resources	Undecided	2,750 (3 plants total)

Technology	Timing	Investment ($ Million)	Change from Original DOE List
CFB	Air Permit (6/2005), In Service - 2008	$800	
CFB	Operational (9/2004), In Service - 2004	800	
Conv. & Fuels Liquef.	Development (1/2006), In Service - 2009	$612	
Conventional	Initiate - 2002, In Service - TBD	$525	
Conventional	Proposed (4/2004), In Service - TBD	$1,000	
CFB	Proposed (4/2005), In Service - TBD	$400	
Conventional	Construction (10/2005), In Service - 2007, 2009	$1,400	
Conventional	Permitting (8/2002), In Service - 2006	$1,000	
Supercritical	Permitting (10/2005), In Service - 2011	$1,000	
Conventional	Proposed (9/2001), In Service - 2007	$1,000	
Conventional	Proposal (7/2005), In Service - 2011	$800	
Conventional	Near Construct. (12/2005), In Service - 2010	$1,000	
Conventional	Permitting (7/2005), In Service - 2010	$1,000	
Conventional	Proposal (2/2006), In Service - 2010	$2,000	
Conventional	Construction as early as 2006, In Service - 2009	$700	Addition
Conventional	Proposed 4/2006	$930	Addition
Conventional	Proposed 4/2006	$930	Addition
Conventional	Proposed 4/2006	$930	Addition
Conventional	Proposed 4/2006	$930	Addition
Conventional	Proposed 4/2006	$930	Addition
Conventional	Proposed 4/2006	$930	Addition
Conventional	Proposed 4/2006	$930	Addition
Conventional	Proposed 4/2006	$930	Addition
CFB	Proposed 2005	$450 (est)	Addition
CFB	Proposed 2005	$450 (est)	Addition
Conventional	Proposed 6/2006	$1,200	Addition
Conventional	Proposed 6/2006	$100 (est)	Addition
Conventional	Development (8/2003), In Service - 2009	$800	
Conventional	Development (7/2005), In Service - 2008	$1,700	
CFB	Proposed (6/2004), In Service - 2008	$350	
Conventional	Permitting (8/2002), In Service - 2005	$1,600	
TBD	Proposed (2/2005), In Service - 2012	$1,000	
Conventional	Assessment (8/2001), In Service - TBD	$2,500	
IGCC	Proposal (1/2006), In Service - 2012	$1,000	
Conventional	Permitting (11/2004), In Service - 2010	$940	
Advanced CFB	DOE Approved - (7/2004), In Service - 2008	$215	
IGCC	Proposed (1/2006), In Service - 2012	$1,000	
Conventional	Proposal (2/2002), In Service - 2005	$300	
Conventional	On Hold - (9/2002), In Service - 2006	$600	
Conventional	Considering (6/2005), In Service - 2010	$500	
Conventional	Proposal - (9/2002), In Service - TBD	$250	
Supercritical	Construction (11/2005), In Service - 2009-10	$2,500	
Conventional	Construction (6/2005), In Service - 2008	$750	
Conventional	Construction (6/2005), In Service - 2008	$450	
Conventional	Applied Air Permit(11/2005), In Service - 2011	$800	
Conventional	Operational (3/2003), In Service - 2003	$100	
Conventional	Construction (1/2006), In Service - 2008	$169	
Fuels Gasification	Proposed (10/2005), In Service - 2010	$740	
IGCC	Development (3/2006), In Service - 2010	$2,500	
Conventional	Considering (12/2005), In Service - 2015	$1,400	
IGCC	Considering (3/2005), In Service - TBD	TBD	
TBD	Considering (6/2005), In Service - 2012	TBD	
Conventional	Initiate - TBD, In Service - TBD	$ 3,300	

Appendix D: Conventional Pollution Increase by State (Est'd.)

State	Number of Proposed Coal-Fired Plants	NO_x (Tons/yr)	SO_x (Tons/yr)	Mercury (lbs/yr)
TX	17	34,575	15,992	889
IL	14	20,751	13,393	523
NV	7	16,590	7,620	444
KY	8	12,507	6,339	298
Undecided	4	9,809	4,505	262
FL	6	9,324	5,606	182
OH	7	8,694	5,571	241
PA	7	8,231	4,073	125
WA	2	7,560	3,998	205
CA	1	7,006	3,218	187
WI	4	6,505	2,988	174
MT	6	6,298	3,031	124
KS	2	6,025	2,767	161
SC	2	5,829	2,677	156
UT	3	5,719	2,676	137
IA	3	5,292	2,430	142
NM	2	5,044	2,317	135
CO	4	4,876	2,239	130
WV	5	4,717	2,708	124
VA	2	4,484	2,060	120
LA	3	4,102	2,037	60
GA	1	3,363	1,545	90
OK	2	3,356	2,067	93
MO	3	3,153	1,448	84
TN	1	2,802	1,287	75
AZ	3	2,795	1,810	78
WY	6	2,677	1,496	73
IN	3	2,536	2,243	74
NE	2	2,466	1,133	66
MN	3	2,445	1,724	65
NC	1	2,242	1,030	60
ID	2	2,032	1,372	57
AR	1	1,864	856	50
ND	2	1,739	891	17
SD	1	1,571	722	42
MS	1	1,233	566	33
MI	1	1,191	547	32
AK	3	1,164	841	33
NY	2	793	1,031	22
CT	1	694	978	22
DE	1	694	978	22
OR	1	553	780	18
MD	1	449	240	1

Notes

1 Energy Information Administration, U.S. Department of Energy, *Annual Energy Outlook 2006 with Projections to 2030*, Table 8: Electricity Supply, Disposition, Prices, and Emissions, February 2006.

2 Ibid.

3 Michael J. Mudd, American Electric Power, *IGCC: Pathway for a Future for Coal*, Presentation, 19 April 2005, Available from the Michigan Public Service Commission at www.cis.state.mi.us.

4 Cumulative government subsidies for nuclear power over the period 1947-1999 have been estimated at $145.4 billion, based on Marshall Goldberg, Renewable Energy Policy Project, *Federal Energy Subsidies: Not All Technologies Are Created Equal*, July 2000. Rates and capital costs: Tony Dutzik et al, National Association of State PIRGs for the National Commission on Energy Policy, *Toward a Consumer-Oriented Electric System: Assuring Affordability, Reliability, Accountability and Balance After a Decade of Restructuring*, June 2004, pages 45-46 and 75-76.

5 Chris Baltimore, "Lawmakers Fret Over Yucca Waste Dump Delays," *Washington Post*, 16 May 2006.

6 See Energy Information Administration, U.S. Department of Energy, *Natural Gas Navigator*, at tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_nus_m.htm.

7 In 2002, the number of producing natural gas wells in the U.S. hit an all-time high, yet aggregate production *decreased* from the year before due to declining well productivity. The average natural gas well operating in 2002 produced half as much gas per day as the average well in operation in 1980, despite improvements in extraction technology. See: U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2003*, 7 September 2004, Table 6.11. Natural gas is a critical fuel to cross the bridge to a carbon-neutral economy. Because natural gas supplies are limited, it should be used as efficiently as possible. Natural gas combined cycle cogeneration plants can deliver heat and electricity with far less carbon pollution than coal, and geothermal and passive solar heat technologies can help improve the efficiency of natural gas use in the residential sector.

8 The 96 million homes figure assumes that 1 GW can supply 1 million homes.

9 In 2004, the U.S. had 335 GW of coal-fired power plants. U.S. Department of Energy, Energy Information Administration, *Electric Power Annual with data for 2004*, November 2005.

10 U.S. Department of Energy, National Energy Technology Laboratory, *Tracking New Coal-Fired Power Plants: Coal's Resurgence in Electric Power Generation*, 20 March 2006.

11 See Appendix and Note 149.

12 Ibid.

13 Ibid.

14 See Note 10.

15 TXU Corporation, *TXU Plans $10 Billion Investment to Power the Future of Texas*, (Press Release) 20 April 2006.

16 NRG Energy, *NRG Announces Comprehensive Repowering Initiative*, (Press Release) 21 June 2006.

17 Mark Golden, "Proposed Western Power Project Would Aid California; Nevada," *Wall Street Journal*, 17 April 2006.

18 FERC Order 888, 1996.

19 For just one recent example, the U.S. National Academy of Sciences released a report validating an experiment that showed that the late 20th century was warmer than at any time in the previous 400 years, and probably much longer. The report also concluded that "human activities are responsible for much of the recent warming." Thomas Maugh and Karen Kaplan, "U.S. Panel Backs Data on Global Warming: Growing Washington Acceptance of Climate Change is Seen in the Top Science Body's Finding," *Los Angeles Times*, 23 June 2006.

20 Faster: Working Group I, Intergovernmental Panel on Climate Change, *IPCC Third Assessment Report – Climate Change 2001: Summary for Policy Makers*, *The Scientific Basis*, 2001; 20 million: Working Group I, Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis*, 2001, Chapter 3.

21 1.4 degrees: National Aeronautics and Space Administration, Goddard Institute for Space Studies, *2005 Was Warmest Year in Over a Century*, (Press Release), 24 January 2006; Unprecedented: Working Group I, Intergovernmental Panel on Climate Change, *IPCC Third Assessment Report – Climate Change 2001: Summary for Policy Makers*, *The Scientific Basis*, 2001.

22 1990s: See IPCC, Note 21; 2005: See NASA, Note 21.

23 Working Group I, Intergovernmental Panel on Climate Change, *IPCC Third Assessment Report – Climate Change 2001: Summary for Policy Makers*, *The Scientific Basis*, 2001.

24 Ibid.

25 Richard Black, "Global Warming Risk 'Much Higher'," *BBC News*, 23 May 2006; M. Scheffer, V. Brovkin, and P. Cox, "Positive Feedback Between Global Warming and Atmospheric CO_2 Concentration Inferred from Past Climate Change," *Geophysical Research Letters* 33, L10702, doi:10.1029/2005GL025044, 26 May 2006; Margaret Torn and John Harte, "Missing Feedbacks, Asymmetric Uncertainties, and the Underestimation of Future Warming, *Geophysical Research Letters* 33, L10703, doi:10.1029/2005GL025540, 26 May 2006.

26 Malte Meinshausen, "What Does a 2° C Target Mean for Greenhouse Gas Concentrations? A Brief Analysis Based on Multi-Gas Emission Pathways and Several Climate Sensitivity Uncertainty Estimates," in Hans Joachim Schnellnhuber, ed., *Avoiding Dangerous Climate Change*, Cambridge University Press, 2006.

27 Rachel Warren, "Impacts of Global Climate Change at Different Annual Mean Global Temperature Increases," in Hans Joachim Schnellnhuber, ed., *Avoiding Dangerous Climate Change*, Cambridge University Press, 2006.

28 James Hansen, "A Slippery Slope: How Much Global Warming Constitutes 'Dangerous Anthropogenic Interference?'" *Climatic Change*, 68:269-279, 2005.

29 See Notes 27 and 26.

30 Ibid.

31 National Research Council, *Abrupt Climate Change: Inevitable Surprises*, National Academies Press, Washington, D.C., 2002.

32 The Intergovernmental Panel on Climate Change, in its 2001 Third Assessment Report, laid out a scenario in which population, economic growth and fossil fuel consumption continue to grow dramatically. Under that scenario, the concentration of carbon dioxide in the atmosphere in 2100 would be nearly three-and-a-half times its preindustrial level, and global average temperatures by the end of the century would be 8° F higher than in 1990. Corresponds to scenario A1F1 in Intergovernmental Panel on Climate Change, *IPCC Third Assessment Report – Climate Change 2001: Synthesis Report*, 2001.

33 See Note 26. Meinshausen estimated that carbon dioxide stabilization at 450 ppm would result in a mean probability of 54 percent that global average temperatures would increase by more than 2° C versus pre-industrial levels. By contrast, stabilizing carbon dioxide concentrations at 400 ppm would reduce the mean probability of exceeding a 2° C increase to 28 percent.

34 See Note 26.

35 Council of the European Union, *Information Note – Brussels*, 10 March 2005; European Environment Agency, *Climate Change and a European Low Carbon Energy System*, EEA Report No 1/2005, ISSN 1725-9177, 2005.

36 See Note 25.

37 Coal-fired power plants produced 52 percent of all electricity generated in the U.S. in 2004. U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004*, 15 August 2005, Table 8.2a.

38 U.S. Department of Energy, Energy Information Administration, *Emissions of Greenhouse Gases in the United States*, December 2005; U.S. Department of Energy, Energy Information Administration, *International Energy Annual 2003*, 11 July 2005.

39 U.S. Department of Energy, Energy Information Administration, *U.S. Electric Power Industry Estimated Emissions by State (EIA-767 and EIA-906)*, 15 December 2004.

40 Data for the U.S. electricity sector in 1999. U.S. Department of Energy, Energy Information Administration, *Carbon Dioxide Emissions from the Generation of Electric Power in the United States*, July 2000.

41 U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004*, 15 August 2005, Table 12.7b.

42 This figure was calculated using a list of proposed coal-fired power plants, their sizes and the proposed technology. (See Appendix and Note 149.) We estimated fuel consumption at each plant by assuming an 80 percent capacity factor and using the following heat rates: IGCC plants: 8,630 BTU/kWh, Supercritical Pulverized Coal: 8,690 BTU/kWh, Conventional Pulverized Coal: 9,300 BTU/kWh (Source: Stu Dalton, Electric Power Research Institute, *Cost Comparison: IGCC and Advanced Coal*, Presented at the Roundtable on Deploying Advanced Clean Coal Plants, Washington D.C., 29 July 2004) and Circulating Fluidized Bed: 9,500 BTU/kWh (Source: Michael J. Mudd, American Electric Power, *IGCC: Pathway for a Future for Coal*, Presentation, Available from the Michigan Public Service Commission at www.cis.state.mi.us, 19 April 2005). We translated fuel consumption in BTU into carbon dioxide emissions using the conversion factor 25.98 million metric tons of carbon equivalent per quadrillion BTU (U.S. Department of Energy, Energy Information Administration, *Documentation for Emissions of Greenhouse Gases in the United States 2003*, May 2005) and converting carbon equivalent into carbon dioxide by multiplying by 44/12 (the ratio of the molecular weight of carbon dioxide to carbon). 2004 electric sector carbon dioxide emissions: Energy Information Administration, U.S. Department of Energy, *Emissions of Greenhouse Gases in the United States, 2004*, December 2005.

43 Overall carbon dioxide pollution in the U.S. in 2004 was 5,973 million metric tons, and world emissions are estimated at 24,405 million metric tons. Energy Information Administration, U.S. Department of Energy, *Emissions of Greenhouse Gases in the United States, 2004*, December 2005.

44 Seth Stevenson, "Sex Sells. But Can Sex Sell Coal?" *Slate*, 31 May 2005.

45 Jeff Johnson, "Getting to Clean Coal: U.S. Faces a Rocky Path to Clean Up Coal-Fired Electric Power Plants in an Era of Shrinking Federal Dollars and Fewer Regulations," *Chemical and Engineering News* 82: 20-25, 23 February 2004.

46 Idaho National Laboratory, *Big Sky Partnership to Bury Greenhouse Gas in Lava Rock*, (Press Release), 4 November 2005.

47 Conventional pulverized coal plants are the standard type of coal-fired technology commonly found across the U.S. Coal gasification technology incorporates a gasifier to turn the coal into a gas before burning it in a combined cycle turbine, much like a natural gas plant. Circulating fluidized bed coal plants use crushed limestone and recycle it to improve fuel combustion. Supercritical plants burn coal at high temperature and achieve greater efficiency.

48 With carbon capture and storage, the Electric Power Research Institute estimates that the levelized cost of electricity in 2003 cents per kWh would be 7.98 from pulverized coal, 7.49 from natural gas (assuming gas costs of $5/Mbtu), and 6.53 from IGCC: Stu Dalton, Electric Power Research Institute, *Cost Comparison: IGCC and Advanced Coal*, Presented at the Roundtable on Deploying Advanced Clean Coal Plants, Washington D.C., 29 July 2004. In comparison, typical efficiency programs deliver savings for roughly 3 cents per kWh. For example, efficiency programs in New England in 2002 achieved lifetime savings of 10 billion kilowatt-hours (kWh) of electricity at an average cost of 2.4 cents per kWh, according to the Regulatory Assistance Project: Richard Sedano, Regulatory Assistance Project, *Economic, Environment and Security Effects of Energy Efficiency and Renewable Energy: A Report for EPA and the New England Governors' Conference*, NEEP Policy Conference, 24 May 2005. The U.S. EPA estimates that wind costs between 4 and 6 cents per kWh, with windier areas producing power for lower cost: U.S. Environmental Protection Agency, *Clean Energy-*

Environment Guide to Action: Policies, Best Practices, and Action Steps for States, 7 February 2006. For example, wind supply curves prepared by the Western Governors Association predict that the best 110 MW of wind power in the region could produce power for a levelized cost of about 5.4 cents per kWh, including some transmission costs but without the benefit of the production tax credit; Western Governors Association, Clean and Diversified Energy Initiative, *Wind Task Force Report*, March 2006. EPRI estimates that in 2010, biomass energy will cost about 6.1 cents per kWh (in 2003 dollars); Steve Specker, Electric Power Research Institute, *Generation Technologies in a Carbon-Constrained World*, presented at the Resources for the Future Policy Leadership Forum, Washington D.C., 30 March 2006. Western Resource Advocates predict that geothermal energy will cost about 5.6 cents per kWh (2003 dollars); Western Resource Advocates, *A Balanced Energy Plan for the Interior West*, 2004.

49 IGCC: Steve Specker, Electric Power Research Institute, *Generation Technologies in a Carbon-Constrained World*, presented at the Resources for the Future Policy Leadership Forum, Washington D.C., 30 March 2006. Efficiency programs in New England in 2002 achieved lifetime savings of 10 billion kilowatt-hours (kWh) of electricity at an average cost of 2.4 cents per kWh, according to the Regulatory Assistance Project: Richard Sedano, Regulatory Assistance Project, *Economic*, *Environment and Security Effects of Energy Efficiency and Renewable Energy: A Report for EPA and the New England Governors'Conference*, NEEP Policy Conference, 24 May 2005.

50 Ibid, Steve Specker.

51 See Note 48.

52 U.S. Department of Energy, Energy Information Administration, *Annual Energy Review 2004*, Table 12.7a, 15 August 2005.

53 See Note 49, Steve Specker.

54 Richard Kerr, "A Possible Snag in Burying CO2," *Science*, 30 June 2006.

55 John Pickrell, "Oceans Found to Absorb Half of All Man-Made Carbon Dioxide," *National Geographic News*, 15 June 2004.

56 United Nations Framework Convention on Climate Change, *Kyoto Protocol: Status of Ratification*, 18 April 2006.

57 Gregory J. Nickels, Mayor, City of Seattle, *U.S. Mayors Unanimously Endorse Nickels' Climate Protection Agreement*, (Press Release), 13 June 2005.

58 State of New Mexico, Office of the Governor, *Governor Bill Richardson Announces Historic Effort to Combat Climate Change*, (Press Release), 9 June 2005.

59 Mark Martin, "Governor Acts to Curb State's Gas Emissions; Goals Put Him at Odds with Many in GOP," *San Francisco Chronicle*, 2 June 2005.

60 California Public Utilities Commission, *PUC to Set Cap on Greenhouse Gas Emissions Produced While Generating Electricity*, (Press Release), 16 February 2006.

61 H.R. 6, Sec. 1612, 2005.

62 Regional Greenhouse Gas Initiative, *States Announce RGGI Agreement: Memorandum of Understanding*, 20 December 2005.

63 Environment Maryland, *Governor Signs Healthy Air Act*, (Press Release), 6 April 2006.

64 John Machacek, "New York, Six Other States Plan to Sue EPA over Emissions," *Gannett News Service*, 20 February 2003; Eliot Spitzer, Office of the Attorney General of New York, *States Sue EPA for Violating Clean Air Act and Refusing to Act on Global Warming*, (Press Release), 27 April 2006.

65 H. Josef Herbert, "High Court Mulls Greenhouse Gas Regulation," *Associated Press*, 26 June 2006.

66 Lucy Johnston et al, Synapse Energy Economics, Inc., *Climate Change and Power: Carbon Dioxide Emissions Costs and Electricity Resource Planning*, 18 May 2006.

67 Assuming natural gas fuel prices of $5/MBtu, Pittsburgh #8 coal at $1.50/MBtu, capacity factors of 80 percent and cost of CO2 transportation and sequestration at $5/metric ton: Stu Dalton, Electric Power Research Institute, *Cost Comparison: IGCC and Advanced Coal*, Presented at the Roundtable on Deploying Advanced Clean Coal Plants, Washington D.C., 29 July 2004.

68 Ibid.

69 Tony Dutzik et al, National Association of State PIRGs for the National Commission on Energy Policy, *Toward a Consumer-Oriented Electric System: Assuring Affordability, Reliability, Accountability and Balance After a Decade of Restructuring*, June 2004, page 42.

70 Carbon Disclosure Project, *Carbon Disclosure Project 2005*, September 2005.

71 Jeffrey Ball, "Insurers Weigh Moves to Cut

Liability for Global Warming: Directors, Officers Could Face Denial of Coverage After Rules are Implemented," *Wall Street Journal*, 7 May 2003.

72 For examples of companies that have had their ratings downgraded: Xcel Energy, which serves more than 3 million customers in the Midwest and West, saw its bond rating downgraded two notches due to the bankruptcy of a non-regulated generation subsidiary: "more than 3 million" from Xcel Energy, *About Xcel Energy*, downloaded from www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_4795-127-0_0_0-0,00.html, 22 March 2004; "downgraded two notches" from Jeffrey Wolinski, Standard & Poor's, *Is PUHCA Beneficial or Detrimental to U.S. Utilities' Credit*, 19 February 2004; TXU, which recently proposed building 11 new coal-fired power plants in Texas, faces the risk of lower credit ratings because it could be overextended by the $10 billion plan: Associated Press, "S&P May Downgrade TXU's Credit Ratings," *Associated Press Financial Wire*, 16 June 2006.

73 "Public Citizen Criticizes TXU's Plan to Capitalize on Emissions Credits from its Planned Coal Plants," *Global Power Report*, 25 May 2006.

74 The National Center for Tobacco-Free Kids, *The Federal Lawsuit Against the Cigarette Companies*, (Factsheet), 15 July 2001, available at www.tobaccofreekids.org.

75 Spencer Hsu, "Insurers Retreat From Coasts: Katrina Losses May Force More Costs on Taxpayer," *Washington Post*, 30 April 2006.

76 650 million: "Court Dismisses CO2 Case Brought Against Power Giants," *Platts Coal Outlook*, 19 September 2005; 11 percent: Energy Information Administration, U.S. Department of Energy, *Emissions of Greenhouse Gases in the United States, 2004*, December 2005.

77 Michael Hill, "Judge Dismisses Utility Lawsuit Brought by States," *Associated Press*, 15 September 2005.

78 Friends of the Earth and Greenpeace, *Lawsuit Explained*, (Factsheet), downloaded from www.climatelawsuit.org on 18 May 2006.

79 Judge Jeffrey White, U.S. District Court, Northern District of California, *Order Denying Defendant's Motion for Summary Judgment*, Friends of the Earth et al. v. Peter Watson and Phillip Merrill, Case 3:02-cv-04106, Document 117, 23 August 2005.

80 Assuming coal with an energy content similar to Wyoming Powder River Basin coal. This number could be larger or smaller, depending on the energy content of the coal.

81 The percentage increase in demand would depend on the energy content of the coal extracted. Assuming an energy content similar to Wyoming Powder River Basin coal, coal demand would increase by about 34 percent. The U.S. used 1.13 billon short tons of coal in 2005 and power plants alone consumed 1.04 billion short tons; Energy Information Administration, U.S. Department of Energy, *Quarterly Coal Report: U.S. Coal Consumption by End-Use Sector*, 17 March 2006.

82 Rebecca Smith, "Railroads Struggle to Deliver Coal to Utilities," *Associated Press Financial Wire*, 15 March 2006.

83 "Rail Shipment Woes Inflate TVA Fuel Costs," *Chattanooga Times Free Press*, 3 April 2006.

84 "Slow Coal Delivery Cuts 460 MW South Dakota Plant Output 25%," *Electric Power Daily*, 22 March 2006.

85 See Note 82.

86 Ibid.

87 As quoted in Note 83.

88 See Note 82.

89 Ibid.

90 Note: The different types of coal vary in price because of differences in energy content, differences in sulfur content, and whether the coal comes from a surface or underground mine. Reprinted from: Energy Information Administration, U.S. Department of Energy, *Coal News and Markets: Week of May 5, 2006*, 9 May 2006.

91 Reserves: Energy Information Administration, U.S. Department of Energy, *Annual Coal Report: Table 14. Recoverable Coal Reserves and Average Recovery Percentage at Producing Mines by State, 2004, 2003*, September 2005; In 2005 power plants consumed 1.04 billion short tons of coal: Energy Information Administration, U.S. Department of Energy, *Quarterly Coal Report: U.S. Coal Consumption by End-Use Sector*, 17 March 2006.

92 Energy Information Administration, U.S. Department of Energy, *Coal Resources, Reserves, and Mine Sizes, U.S. Total*, 13 May 2002.

93 U.S. Department of Energy, Energy Information Administration, *Annual Coal Report*, September 2005.

94 U.S. Environmental Protection Agency, 2004 Toxics Release Inventory data for the coal

mining industry, downloaded from *TRI Explorer*, www.epa.gov/triexplorer/, 12 April 2006.

95 Public Citizen, *Coal Combustion Waste*, (Factsheet), downloaded from www.citizen.org/texas on 13 June 2006.

96 U.S. Environmental Protection Agency, *Draft Programmatic Environmental Impact Statement on Mountaintop Mining*, 2003.

97 Ibid.

98 Don Hopey, "How Longwall Mining Works," *Pittsburgh Post-Gazette*, 23 November 2003.

99 These calculations were made with the assumptions listed in Table 3, below. Emissions rates: Western Governors' Association, *Technology Working Group Reports: Advanced Coal Task Force*, downloaded from www.westgov.org, 2 May 2006. To arrive at the results reported, we averaged the lower and upper estimates of emissions. We estimated fuel consumption at each plant as described in Note 42.

100 Assuming that capital costs are 57 percent of the levelized cost of coal. U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2006*, January 2006, Figure 58.

101 Steven Nadel, Anna Shipley, and R. Neal Elliot, American Council for an Energy Efficient Economy, *The Technical, Economic, and Achievable Potential for Energy Efficiency in the U.S.—A Meta-Analysis of Recent Studies*, From the *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings*, American Council for an Energy Efficient Economy, 2004.

102 Richard Sedano, Regulatory Assistance Project, *Economic, Environment and Security Effects of Energy Efficiency and Renewable Energy: A Report for EPA and the New England Governors' Conference*, NEEP Policy Conference, 24 May 2005.

103 Optimal Energy, Inc. for Northeast Energy Efficiency Partnerships, *Economically Achievable Energy Efficiency Potential in New England*, May 2005.

104 Howard Geller et al, Southwest Energy Efficiency Project, *The New Mother Lode: The Potential for More Efficient Electricity Use in the Southwest*, November 2002.

105 Ibid.

106 Estimate based on extrapolating the results of *The New Mother Lode*. Reducing demand by 100,000 GWh/year in 2020 in that study required an investment of $8.85 billion in 2000 dollars. Extrapolating to the U.S. as a whole, anticipating similar results at 33 percent greater cost would yield savings of 1 million GWh/year for $138 billion in 2006 dollars.

107 Business as usual: U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2006*, January 2006. Efficiency estimate as described in text.

108 Assuming an 80 percent capacity factor.

109 U.S. Department of Energy, Office Energy Efficiency and Renewable Energy, *Wind Powering America: Clean Energy for the 21st Century*, downloaded from www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/wpa/35873_21century.pdf, 2 March 2005.

110 U.S. Department of Energy, National Center for Photovoltaics, *How Much Land Will PV Need to Supply Our Electricity*, downloaded from www.nrel.gov/ncpv/land_faq.html, 3 March 2005.

Table 3. Emissions Rates (in lbs per million BTU)

Technology	Heat Rate	Capacity Factor	NOx Emission Rate (lower limit)	NOx Emission Rate (upper limit)	SO2 Emission Rate (lower limit)	SO2 Emission Rate (upper limit)	HG Emission Rate (lower limit)	HG Emission rate (upper limit)
Conventional	9300	0.8	0.072	0.1	0.059	0.02	0.0000006	0.0000017
CFB	9500	0.8	0.075	0.075	0.04	0.04	0.0000000816	0.00000013
Supercritical	8690	0.8	0.072	0.1	0.059	0.02	0.0000006	0.0000017
Gasification	8630	0.8	0.011	0.05	0.016	0.07	0.00000047	0.0000005

111 U.S. Department of Energy, Energy Information Administration, Annual Energy Outlook 2006, January 2006, Figure 61.

112 Colorado Public Utilities Commission, *Initial Commission Decision Approving Stipulation and Settlement Agreement*, Decision No. C02-1122, 2 October 2002.

113 Assuming that the current transmission network has an average of 20 percent spare capacity and without taking into account the cost of distribution or the benefit of the production tax credit; Western Governors Association, Clean and Diversified Energy Initiative, *Wind Task Force Report*, March 2006.

114 Ibid.

115 Levelized cost for a new coal plant in 2015 in 2004 dollars: U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2006*, January 2006, Figure 58.

116 Assuming coal has a capacity factor of 80 percent and wind 30 percent.

117 Assuming capital costs for a full wind facility of about $1.2 million per MW. See for example: DKRW Energy LLC, *Growth and Future: Wind Energy*, Presented at 2006 Wind Energy Institute, 1 June 2006.

118 More effective turbine models that can operate more efficiently at lower average wind speeds have been coming out every 1 to 3 years. These advances help push down the price of wind and allow larger areas to support wind farms; See Note 113.

119 See Note 49, Steve Specker.

120 In July 2005, Congress extended the 1.8 cents/kWh production tax credit to the end of 2007. Because the tax credit has expired and been renewed regularly, it has not provided the stable financial environment that would truly support a massive expansion of wind power.

121 "$20 per peak Watt" from U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Building Science Consortium's PV Primer*, downloaded from www.eere.energy.gov/buildings/building_america/pdfs/db/35206.pdf, 17 November 2004. "About $3.50 today" based on low price for individual module in Solarbuzz price survey, www.solarbuzz.com/ModulePrices.htm, downloaded 17 November 2004. Lower prices are available for modules purchased in larger quantities.

122 "Silicon Wafer Prices Increase Again," *Techweb*, 8 May 2006.

123 Nanosolar, Inc., *Nanosolar to Build 430 MW Solar Cell Factory*, (Press Release), 21 June 2006.

124 Clean Power Research and Austin Energy, *The Value of Distributed Photovoltaics to Austin Energy and the City of Austin*, 16 March 2006.

125 Sandia National Laboratory, Sun-Lab, *Big Solutions for Big Problems*: *Concentrating Solar Power*, (Factsheet), 10 January 2002.

126 Ibid.

127 Solar Energy Industries Association, DOE Concentrating Solar Power Program and Sandia National Laboratory, *Why Nevada Should Develop its Solar Energy Resource*, 20 August 2003.

128 Solargenix, *Solargenix Approved to Proceed with Largest Solar Electric Power Plant Project in the World in 14 Years*, (Press Release) 21 September 2005.

129 Randy Gee, Solargenix, personal correspondence, 7 July 2006.

130 For details, see www.stirlingenergy.com.

131 See Note 125.

132 Tom Mancini, Sandia National Laboratory, personal communication, 6 July 2006. The U.S. Department of Energy and EPRI predict that solar tower technologies will have a capital cost of around $1 million per MW by 2010: U.S. Department of Energy, EPRI, *Renewable Energy Technology Characterizations*, (Solar Thermal Technologies: Solar Power Tower), EPRI Topical Report No. TR-109496, December 1997.

133 See Note 127.

134 National Renewable Energy Laboratory, *Geothermal Energy Program*, October 2001.

135 U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Wind Energy for Rural Economic Development*, revised August 2004.

136 See Note 123.

137 Navin Nayak, U.S. PIRG Education Fund, *Redirecting America's Energy: The Economic and Consumer Benefits of Clean Energy Policies*, February 2005.

138 Union of Concerned Scientists, *Renewing America's Economy*, September 2004.

139 Regional Greenhouse Gas Initiative, *States Announce RGGI Agreement : Memorandum of Understanding*, 20 December 2005.

140 See Note 59.

141 See Note 58.

142 Michelle Dunlop, "Coal Plant Moratorium

Sails Through Senate," *Times-News* (Twin Falls, Idaho), 30 March 2006.

143 "NCC Study Claims Maximizing Coal Use Will Reduce Energy Costs; Idaho Lawmakers Restrict Coal-Fired Plant Development," *Foster Electric Report*, 29 March 2006.

144 Management Information Services, *Federal Incentives for the Energy Industries*, 1998.

145 For example: Government Accountability Office (formerly General Accounting Office), *Fossil Fuel R & D: Lessons Learned in the Clean Coal Technology Program*, (GAO-01-854T), June 2001. There have been at least six other reports in the past twenty years.

146 See Note 144.

147 California Public Utilities Commission, California Energy Commission and California Power Authority, *Joint Agency Energy Action Plan (EAP)*, 2003. Maine and Rhode Island have similar policies.

148 American Council for an Energy-Efficient Economy, Appliance Standards Awareness Project, *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, March 2006.

149 To develop this list, we began with a database of proposals compiled by the U.S. Department of Energy, dated March 2006. (U.S. Department of Energy, National Energy Technology Laboratory, *Tracking New Coal-Fired Power Plants: Coal's Resurgence in Electric Power Generation*, 20 March 2006.) The plants listed in the database are at various stages in the approval process—some are only proposals and may never move beyond that stage, some are approved and already under construction. We updated the list with changes we were aware of as of June 2006. These changes may not be fully comprehensive; it is possible that we are not aware of some number of new proposals or changes in the status of existing proposals. Additions and changes to the original DOE list are indicated in the far right-hand column. Deletions from the original DOE list include: DOE, Colorado Springs (Colorado Springs did not apply for the DOE grant); Florida Power & Light, Crystal River, Florida (operational 2001); Florida Municipal Power Agency, Florida (Partnered with JEA on the Taylor Energy Center, an 800 MW plant planned for Taylor County); Comanche Park LLC, Yellowstone City, Montana (Power purchaser went bankrupt); Nevada Power 500 MW (Now Sierra Pacific 1,500 MW); Steag Power / Navajo Nation, Farmington, New Mexico (Duplicate listing with Sithe Global Power, New Mexico); and Pacificorp, Oregon (Could not verify).

150 "FP&L Seeks Waiver of Solicitation Process; to Bid to Self-Build Two 850 MW Coal Plants," *Platts Electric Utility Week*, 12 June 2006.

151 Sempra Energy is selling the rights to its Granite Fox and Idaho projects and considers them still valid. Jane Braxton Little, "Sempra Selling Rights to Power Project," *Sacramento Bee*, 8 April 2006.

152 Ibid.

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