Coal and Global Warming

David G. Hawkins, Natural Resources Defense Council
Submission to Senate Energy Committee
February 16, 2005

Executive Summary for Coal Conference

The future of coal in the U.S. electric power sector is an uncertain one. The major cause of this uncertainty is the government's failure to define future requirements for limiting greenhouse gas emissions, especially carbon dioxide (CO_2). Coal is the fossil fuel with the highest uncontrolled CO_2 emission rate and coal power plants are expensive, long-lived investments. Key decision makers understand that the problem of global warming will need to be addressed within the time needed to recoup investments in power projects now in the planning stage. Since the status quo is unstable and future requirements for coal plants and other emission sources are inevitable but unclear, there will be increasing hesitation to commit the large amounts of capital required for new coal projects.

While the U.S. EIA and others predict strong growth in new U.S. coal capacity, those predictions are based on computer models that ignore the changing policy landscape. Community opposition, new requirements from utility commissions and other state agencies, litigation, and investor hedging all are likely to result in substantially less new coal capacity being built unless and until requirements for global warming emission control are defined.

The environmental and economic penalties of further delay in establishing programs to limit global warming emissions are severe. The long life of CO_2 in the atmosphere and the long lives of energy investments, especially coal-fired power plants, create a buildup of heat-trapping gases that will continue to produce adverse impacts long after emission reduction efforts begin. The longer we wait to start cutting emissions, the more costly and disruptive it will be to avoid any particular climate protection goal. To avoid harmful impacts of climate change tomorrow we must begin to change investment decisions today.

Energy efficiency and renewable energy are well-known low-carbon methods that are essential to any climate protection strategy. But technology exists to create a sustainable path for continued coal use as well. Methods to capture CO_2 from coal gasification plants are commercially demonstrated, as is the injection of CO_2 into geologic formations for disposal. However, these systems will not be brought to market in the absence of a program that requires limits on CO_2 emissions. Combining such limits with financial incentives to deploy CO_2 capture and storage technologies is economically and politically feasible and would serve a number of important strategic interests of the U.S. and its allies.

Congress should enact such a program without further delay.

Coal Consumption: What are the likely future scenarios for the role of coal-fired generation in the U.S.?

Coal's future as an option for generating electricity will be determined in large part by how our society responds to the problem of global warming, which is caused predominantly by emissions of carbon dioxide (CO_2) from the combustion of coal and other fossil fuels. Forty percent of U.S. CO_2 emissions comes from electric power generation, the largest source of global warming pollution in the United States.

Coal is abundant both in the U.S. and in a number of other countries. We have used coal to our economic advantage in the U.S., fueling our industrial growth and helping to bring electricity to nearly every home and hamlet in our country. There is no denying that our use of the coal has brought great benefits.

There is also no denying that our use of coal has caused great harm to the health of workers, the general public, and the environment. As our representatives, you have begun to tackle some of the health and environmental problems caused by coal use.[1] But the problem of global warming is one that you have not yet decided to address in a serious manner.

The current policy impasse on global warming is dysfunctional: it will not protect people from global warming and it will not produce a sustainable coal industry. The coal industry must acknowledge, like it or not, that the problem of global warming cannot be denied or wished away. Environmental advocates must acknowledge, like it or not, that the use of coal cannot be wished away. Denial of these facts is not a strategy for success for either group's priorities or for society's interests. Absent a real change in policy, the future is not bright for an hospitable climate, either for people or for the coal industry in the U.S.

The U.S. Energy Information Administration (EIA) forecasts an expanding coal industry here in the U.S., but I question the reality of those projections. Today we consume about 1.1 billion tons of coal annually; about 91% for electricity production in the nation's roughly 330 gigawatts (GW) of coal-fired power plants. In its latest forecast, EIA estimates that U.S. coal consumption will increase to 1.5 billion tons in 2025, due largely to a predicted boom in new coal plant construction. EIA's economic model calculates that about one-third of new electricity capacity built in the U.S. from now to 2025 will be coal-fired – some 87 GW of capacity (about 250 medium-sized units) out of a total new build of 263 GW. That works out to one new coal plant a month for the next 20 years. How plausible is that? Not very, in my view.

How do these forecasts compare with recent history? Well, they represent a radical change in investment behavior. From 1990 through 2002 nearly 200 GW of new electric plant capacity was built: 95% of that new capacity were gas or gas/oil fired units; less than 4% were coal units. What real commitments lie behind EIA's predictions? Not

[1] Attached to this submission are NRDC's views on the substantial remaining problems of conventional air pollution and land and water impacts from extraction of coal.

much. Of the 87 GW of predicted new coal capacity, only 1.8 GW represent plants that actual companies say they are committed to build; the balance EIA terms "unplanned"—that is, capacity that the computer plans to build based on the model's economic assumptions.

But the model's economics are fundamentally flawed because they ignore the facts that will drive behavior of key players in the real world. Most fundamentally, EIA's model ignores the fact that the problem of global warming will not go away in the real world or in the policy world. Key players know that coal plants will have CO_2 emission rates more than double that of the biggest competitor, natural gas. They know that it takes around a billion dollars and perhaps 10 years to build a 1 GW coal plant. They know that in the decade that passes before a coal plant being planned today actually starts operation, the policy landscape will change: evidence of the impacts of global warming will continue to accumulate; the public and policymakers will come to understand how little time we have to reshape energy systems to address global warming; states, utility commissions and maybe even the Congress of the United States will adopt policies the stop the use of the atmosphere as a completely free dump for CO_2. Even the most bullish will ask themselves, how likely is it that policies on global warming will be locked in cement, not just for the next decade but for the 15-20 years following when the plant's investment is being recouped and the 40 years after that period when the plant will still be relied upon to supply power?

Community opposition to new coal projects is already a fact of life and that opposition will intensify if the proponents have no plans to limit global warming emissions from the projects. Investors know what controversy in new plant permitting means: it means investment risk. When the difficulties of getting a new coal plant permitted are added to the risks lurking in the murky policy picture for addressing CO_2 emissions, investors will increasingly want to hedge their bets and look for options other than conventional coal plants, most likely options other than coal.

Economic regulators are waking up to the fact that if they approve new investments in high carbon-emitting projects, they will be sticking ratepayers with the bill for a bad investment. For example, last December the California Public Utilities Commission issued an order requiring all new significant resource investments to include a "shadow" abatement cost for CO_2 emissions for comparing and choosing alternative energy resources. Companies like PacifiCorp and Idaho Power are already incorporating "adders" for CO_2 into their resource planning decisions.

These are only a few of the developments that make the EIA predictions for new coal plant construction implausible. But while fewer coal plants may get built, that will not solve either our environmental or our energy problems. We need a coherent policy framework that addresses both the need to deploy "climate-friendly" energy resources and the value of diverse, secure sources of supply.

In NRDC's view energy and environmental policies should be designed to accelerate our reliance on efficiency, renewable energy, other cleaner fuels as the

backbone of our energy portfolio. But we believe fossil fuels with CO_2 capture and storage can have an important role too. The Committee has held one meeting on natural gas and I hope will schedule meetings on efficiency and renewables resources. Since this meeting is about coal, I will focus on that topic in this submission.

If we continue to delay adoption of a real program to address global warming, the most likely scenario is that between now and 2025 some of EIA's forecasted new coal plants will be built, some of today's coal capacity will be retired and that our dependence on natural gas for power generation will continue to grow dramatically. What will not happen under this scenario is the emergence in the market of economic advanced coal plants that capture their CO2 for safe disposal in geologic formations. It is important to be clear about the dangers of this path.

A Dangerous Path. Unlike conventional pollution problems, global warming is a problem with enormous built-in inertia. Most conventional pollutants wash out of the air within a few days or weeks, meaning that atmospheric pollution levels come down almost immediately after emission reductions are put in place. In contrast, CO_2 stays in the atmosphere for hundreds of years. Once the atmospheric concentration of CO_2 and other greenhouse gases has been raised, it *stays* raised. As a practical matter, it will take generations, even centuries, to lower the concentrations once they are raised. This means that loading the atmosphere with greenhouse gases locks us in to decades, even centuries of impacts caused by that buildup. For all practical purposes, we cannot go backward.

Not only are greenhouse gases very long-lived, the biggest emitters of these gases are long-lived too. Coal plants in particular have very long lifetimes. Plants being planned now will likely still be operating when we celebrate the 300th anniversary of our independence in 2076. If the plants are not designed upfront to capture their CO_2, they will likely lock us into an unabated stream of greenhouse emissions for their entire operating life. In rough terms, every 10 GW of new coal plants will produce lifetime emissions of 4 billion tons of CO_2 (1 billion metric tonnes of carbon). This "carbon lock-in" will cost us both in damage from global warming and economic disruption when we decide to act.

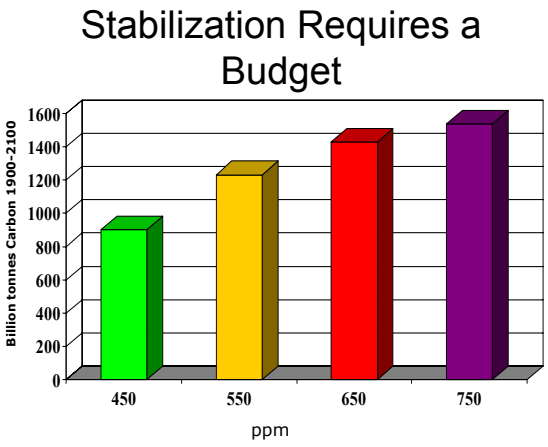
None of us wants to make decisions today that will inflict harm on our children, our loved ones, or even innocent strangers. But too many good people just aren't sure if that's what we are doing with the energy investments we are making today. Understanding the basics of global warming is the first step in making good decisions. There are four links in the chain from investments today to adverse climate changes tomorrow.

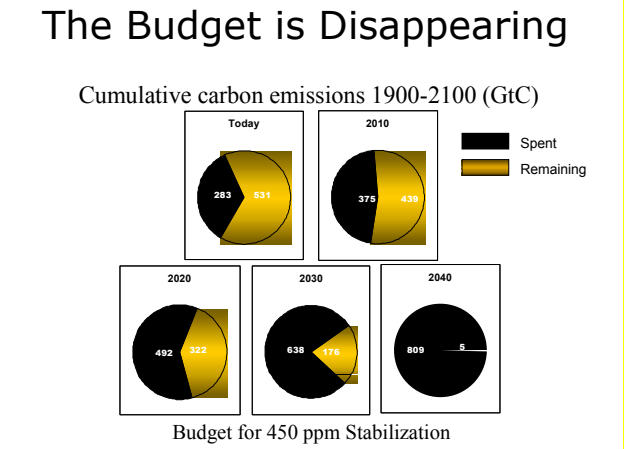
First, today's investments drive emissions for decades, as I have described. Second, emissions growth results in increased concentrations of heat-trapping gases in the atmosphere that will persist for centuries. Third, the heat-trapping increases the amount of energy in the atmosphere, which changes the patterns of winds, temperatures and precipitation that we call "climate." Fourth the changes in climate can produce extremes of wet, dry, hot, cold, stormy weather patterns that are dramatically different from the

conditions modern human societies and today's ecosystems have experienced. The critical point is that each link in the chain locks in consequences in the next link. If we want to be sure we do not inflict harm tomorrow, we need to pay attention to the emissions from investment decisions we make today.

The Bush administration has restated its commitment to stabilizing concentrations of greenhouse gases, but it has not examined what we need to do now to achieve stabilization. Where are we on the concentration highway and where are we headed? Before the industrial revolution, the atmosphere contained about 270 parts per million (ppm) of CO_2. Today, atmospheric CO_2 has increased to more than 380 ppm. Many scientists believe we are already seeing concrete impacts of global warming at this level. But we are already committed to concentrations higher than today. The critical question is how much higher will we commit ourselves to: 450 ppm; 550 ppm; 650 ppm; higher still? We cannot put the world on "pause" while we decide this question. Every year that we continue current investments we are deciding to commit to higher concentrations. Each high carbon investment is a new Pandora's Box that our children will open.

The cumulative emissions from investments we have made and those we are making today will decide what targets we can still meet. The first figure below shows for each of these concentration targets, the maximum tonnage of CO_2 that can be emitted on a global basis over the two centuries from 1900 through 2100.

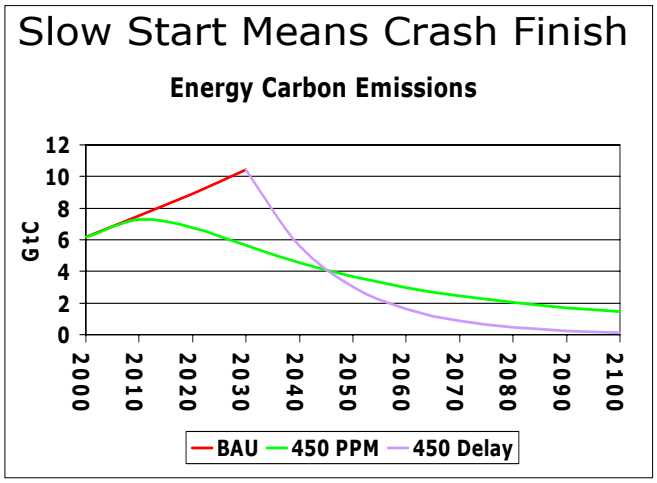




The second figure illustrates how fast we are eating up these budgets. We have already used up nearly half of the 200-year budget for a goal of avoiding more than 450 ppm CO_2. And because emissions – both here in the U.S. and in the world as a whole – are increasing, the entire budget runs out by 2040. The picture is not much different for riskier targets: For a goal of not exceeding 550 ppm, on present emission trends the budget runs out only a decade later.

Once we grasp these two facts – that for any given CO_2 concentrations there is only a limited budget of CO_2 emissions available, and that you can't go backward once atmospheric concentrations have risen – the costs of delaying emission reductions become clearer: *Unrestrained emissions growth is eating up the global carbon budget,*

locking us into two bad choices – either dangerously high CO_2 levels or crash reductions later.



As a practical matter, our ability to keep concentrations below any of these targets disappears decades before the budget physically disappears. Once the capital is committed to a particular energy investment we have locked in to the lifetime emissions from that investment. To affect these emission budget burn rates, we must alter the investments decisions we are making today. The policy options for altering these investment decisions are considered in answer to Questions 2 and 3.

Environmental: What are the environmental and regulatory challenges associated with the future use of coal for power generation?

Electric power plants are the largest source of global warming pollution in the United States, responsible for 40 percent of U.S. carbon dioxide (CO_2) emissions.[2] Yet past energy bills have not included any binding, effective measures to reduce these emissions, or even limit their growth. Neither does the administration's air pollution bill (S.131). This is not just an omission; it is a policy choice that will take us down the wrong path. It will lock us into dangerous emissions increases and, paradoxically, deny the coal and power industries any long-term stability.

Global Warming Is Real and Urgent. Over the past four years, it has become increasingly obvious that the failure to address emissions of CO_2 and other emissions that cause global warming is out of sync with scientific and economic reality. Scientific evidence continues to accumulate on the reality of global warming and urgency of curbing the CO_2 emissions that are causing it.

The administration's own 2002 Climate Action Report[3] concluded that unless global warming emissions are reduced, average temperatures could rise another 3 to 9 degrees Fahrenheit in the United States by the end of the century – with far-reaching effects: Higher temperatures will worsen air pollution. Sea levels will rise, flooding coastal areas. Heat waves will be more frequent and intense. More droughts and wildfires will occur in some regions, more heavy rains and flooding in others. Species will disappear from historic ranges as habitats are lost.

Other reports produced or endorsed by the administration highlight additional research findings:

- Our Changing Planet 2004-2005,[4] released in August 2004, found that observed global and North American temperatures during the 20th century can be explained only when the effect of heat-trapping gases is included along with natural factors. The report found that the severe Western U.S. drought since 1998 is part of a persistent climate pattern strongly influenced by the tropical oceans and consistent with climate model simulations of future sea surface temperatures. Research also shows that shifts in animal and plant populations due to global warming are already discernible.

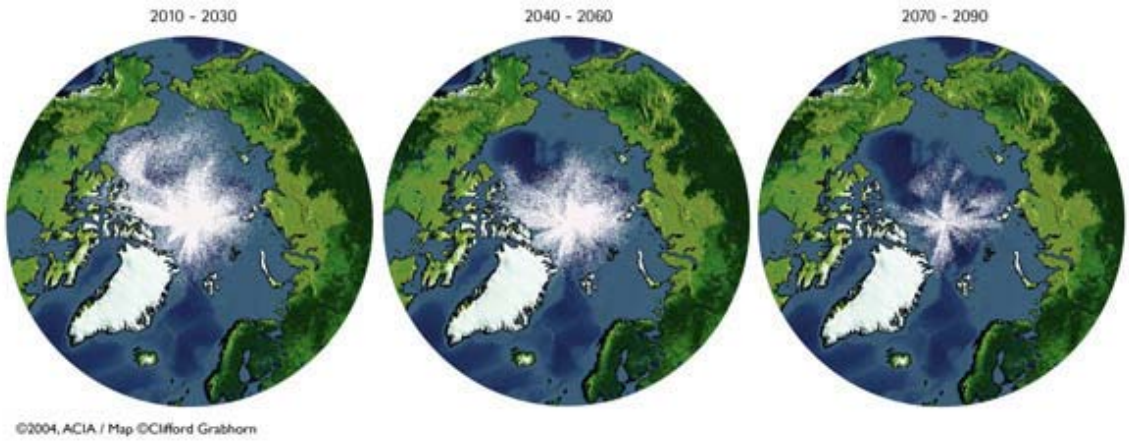
---

[2] This submission is limited to the impacts of coal on global warming. Attachments to this submission discuss other serious remaining problems caused by current patterns of coal extraction and use.

[3] U.S. Department of State, *U.S. Climate Action Report – 2002* 84 (2002), *available at* http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BWHU6/$File/uscar.pdf.

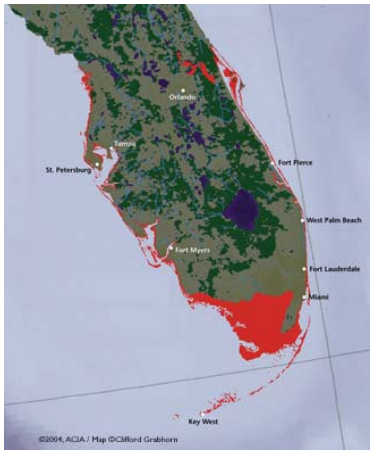
[4] *Our Changing Planet: The U.S. Climate Change Science Program for Fiscal Years 2004 and 2005*, A Report by the Climate Change Science Program and the Subcommittee on Global Change Research, http://www.usgcrp.gov/usgcrp/Library/ocp2004-5/

- The robust scientific consensus was re-stated again last year in the Arctic Climate Impact Assessment[5] – an international scientific report accepted by the U.S. government. According to the Assessment's most conservative estimates, about half the summer sea ice in the Arctic is projected to melt by the end of this century, along with a significant portion of the Greenland Ice Sheet, as the region warms an additional 7 to 13 degrees Fahrenheit by 2100.



Projected loss of Arctic Sea Ice
Source: Arctic Climate Impact Assessment

- The Assessment also found that average winter temperatures in Alaska, Western Canada, and Eastern Russia have increased as much as 4 to 7 degrees F in the past 50 years, and are projected to rise 7-14 degrees F over the next 100 years. Rising sea levels have already been observed worldwide and are predicted to accelerate as warming continues. Low-lying coastal states like Florida and Louisiana are particularly susceptible to rising sea levels.



Impact of 3.3 foot sea level rise.
Source: Arctic Climate Impact Assessment

[5] Statement by Dr. Robert W. Corell, Chair, Arctic Climate Impact Assessment, before the Committee on Commerce, Science, and Transportation, United States Senate (November 16, 2004).

- In December 2004, the scientific journal Nature linked global warming pollution to the European heat wave of 2003 that killed more than 15,000 people. Emissions of CO_2 and other global warming pollutants have already at least doubled the risk of extreme heat waves like 2003 event, according to a team of scientists led by Peter Stott at the British Met Office. As greenhouse gas emissions continue to rise, 2003 temperatures will become the *norm* by the 2040s, with half of the summers being *even hotter* than last year's.[6] A companion paper describes this work as "a breakthrough" – "the first successful attempt to detect man-made influence on a specific extreme climatic event."[7]

- These findings also dramatize the liability risks for companies that emit greenhouse gases, according to a third Nature paper.[8] Global warming pollution has "loaded the weather dice" – raising the chances of repeating the weather conditions of summer 2003 by a factor of two to four, with higher risks to follow as emissions continue to rise. They conclude: "[I]t will become increasingly hard to argue that any resulting damage was unforeseeable," and they predict a rise in litigation to determine who pays for damage caused by global warming.

Industry Leaders Know It. While pockets of denial remain in the business and political worlds, each year more industry leaders and elected officials recognize that scientific consensus makes action on global warming both inevitable and increasingly urgent. These voices include leaders in the electric power industry itself. For example:

- American Electric Power, the nation's largest power company: "Enough is known about the science and environmental impacts of climate change for us to take actions to address its consequences."[9] Linn Draper, AEP's former CEO: "Eventually, you're going to have to have a hard cap of some kind."[10] AEP senior vice-president Dale Heydelauf: carbon constraints are "inevitable."[11]
- John Rowe, CEO of Exelon Corp.: "We accept that the science on global warming is overwhelming." And: "There should be mandatory carbon constraints."[12]
- Jim Rodgers, CEO of Cinergy Corp.: "One day we will live in a carbon-constrained world."[13]
- Wayne Brunetti, CEO of Xcel Energy: "Give us a date, tell us how much we need to cut, give us the flexibility to meet the goals, and we'll get it done."[14]

---

[6] Stott, *et al.*, "Human Contribution to the European Heatwave of 2003," *Nature* (432:610), Dec. 2, 2004.
[7] Schär and Jendritsky, "Hot News from Summer 2003," *Nature* (432:559), Dec. 2, 2004.
[8] Allen and Lord, "The Blame Game: Who Will Pay for the Damaging Consequences of Climate Change?" *Nature* (432:551), Dec. 2, 2004
[9] American Electric Power, *Position Paper on Global Climate Change* 1 http://www.aep.com/environmental/climate/docs/Climate_Change_Position_Paper.pdf
[10] *A Pre-emptive Strike on Global Warming*, (New York Times, May 15, 2001).
[11] *AEP and Cinergy To Outline Ways to Cut Emissions*, Wall Street Journal (Feb. 19, 2004), p. A8.
[12] *Global Warming*, Business Week, Aug. 16, 2004.
[13] "Cinergy: Awakening a Sustainability Giant," GreenBiz, http://www.greenbiz.com/news/reviews_third.cfm?NewsID=27409
[14] *Global Warming*, Business Week, Aug. 16, 2004.

These leaders understand that the current policy impasse makes the U.S. coal industry's future very uncertain. No one really believes action on global warming can be delayed indefinitely, and this is making investors leery of large new investments in conventional coal-fired power plants. On the other hand, without a policy to limit CO_2 emissions over time, most investors are also leery of large investments to develop and deploy advanced coal technologies like gasification and CO_2 capture systems. That is why there is growing understanding in the power sector and the coal industry that we must face up to the need for carbon limits.

Protecting the Planet While Keeping Coal in the Game. As noted in answer to Question 1, we can do three things to limit CO_2 emissions from the electricity sector: First, produce and use electricity more efficiently. Second, dramatically increase our reliance on renewable energy resources. Third, pursue methods to capture and permanently store CO_2 from the fossil energy sources we continue to use.

Adoption of these technologies is proceeding far too slowly to avert reaching exceedingly dangerous CO_2 concentrations. Because fossil-fuel CO_2 can still be emitted to the air in unlimited amounts for free, there is no adequate economic incentive to use and improve existing technology to reduce these emissions. Nor is there an adequate incentive to innovate to bring down the costs of today's gasification and CO_2 capture systems.

The administration and others will point to current voluntary programs and modest public investments in new technology. But we must not fool ourselves into thinking that we can do this with voluntary programs and fiscal incentives alone. Without a real market signal, such as that provided by real limits on CO_2 emissions, voluntary efforts and incentives are not sufficient even to stem the steady increase in power plant CO_2 emissions.

The president's voluntary "emissions intensity" target lets total carbon pollution keep increasing every year at essentially the business as usual rate. Even if the administration's target is met, total U.S. global warming emissions will *increase by 14 percent* between 2002 and 2012 – exactly the same rate as they grew in the 1990s.[15] The power industry's latest voluntary pledge is a promise to keep increasing carbon pollution. The industry plan, announced in December 2004, would let power plant carbon emissions

---

15 NRDC (2002), "Untangling the Accounting Gimmicks in White House Global Warming, Pollution Plans," http://www.nrdc.org/globalWarming/agwcon.asp.

Past voluntary programs have failed. In the DOE "1605(b)" program, power companies claimed to have made nearly 140 million tons of "reductions" even as their total global warming emissions skyrocketed by *420 million tons*. Instead of making real investments to reduce their overall pollution, most power companies simply claimed credit for business-as-usual actions, thus making no real difference in rising emission trends. NRDC (2001), "Reported 'Reductions,' Rising Emissions," http://www.nrdc.org/globalWarming/reductions/execsum.asp.

grow by 15 to 17.5 percent between 2002 and 2012 – about the same rate as the Energy Information Administration's business-as-usual projections.[16]

Without the real market signal from a limit on emissions, the administration's policy of voluntary programs and small investments in technology R&D is an expensive, inefficient, and ineffective strategy for changing emissions trends. The plain fact is that in the absence of a real market signal power sector emissions will keep increasing.

Policies to Send a Real Market Signal. An effective policy must change market signals enough to promote large-scale investment in efficiency, renewables, and advanced coal technologies (gasification with CO_2 capture) in the next decade and beyond. This kind of market signal cannot be provided by voluntary programs and modest fiscal incentives alone. The necessary market signal can be provided only by placing a real limit that slows, stops, and reverses emissions of CO_2 and other global warming pollutants. Including such a limit in legislation will speed the process of bringing advanced technologies to market; leaving a real emission limit out will keep that activity on the back burner.

There are many sensible policies that can be adopted to start limiting CO_2 emissions and there are many compelling reasons to do so. Working together, members of both parties and the administration would be able to identify a path forward that all could embrace and all could point to as a real accomplishment. NRDC will work with you to help make that happen.

[16] *Compare* Edison Electric Institute (2002), "EEI, Industry Allies Launch 'Power Partners' to Support President Bush's Climate Initiative," http://www.eei.org/issues/news/releases/030212.htm, *with* Energy Information Administration (2003), *Annual Energy Outlook 2003*, Reference Case Forecast, Table 19.

Financial and Technological Improvements: What technological improvements in coal use are most important to pursue? What financial and/or regulatory mechanisms are necessary to bring these technological improvements to market?

Critical Technologies for Coal

The critical technology for coal is CO_2 capture and geologic storage. This is the only technology that will make continued coal use compatible with protection of the climate. Some suggest that improvements of 10-20% in conventional coal plant efficiency are an adequate technology response to global warming; this is incorrect. Marginal improvements in coal plant efficiency will not deliver reductions on the scale needed to stabilize concentrations at reasonable levels.

The International Energy Agency (IEA) forecasts that 1400 GW of new coal plants will be built worldwide in the next 25 years alone. To put that in context, current U.S. coal capacity is about 330 GW and global capacity is 1000 GW. This enormous increase in global coal capacity will lock us into a huge additional commitment to global warming unless we use technologies that reduce CO_2 emissions to minimal levels; marginal efficiency improvements will not prevent this lock-in.

The lifetime emissions from just this next wave of new coal investments will be about 580 billion tons of CO_2. That amount is more than half the total loading of the atmosphere with CO_2 from all forms of fossil fuel combustion in the past 250 years! Improving efficiency by 10-20% at all these new plants would cut the total added burden by only that modest amount, leaving us with hundreds of billons of tons of added CO_2 in the atmosphere just from the operation of these plants.

The three required elements of a coal-based CO_2 capture and storage system (CCS) have all been demonstrated at commercial scale in numerous projects around the world. But there is large potential for optimization of each element to bring down costs and improve efficiency. In addition, the experience with large scale injection of CO_2 into geologic formations is still limited.

For coal, the first element of a CCS system is a method to convert coal into useful energy that produces a waste stream that makes CO_2 capture relatively inexpensive. The method for doing this that is commercially demonstrated is gasification of coal. In contrast to the conventional coal combustion methods used in electric power generation, gasification converts the coal under pressure and temperature to produce a smaller gas stream with higher CO_2 concentrations. This approach significantly reduces the cost and energy required to capture CO_2. Coal gasification is in operation in hundreds of installations around the world. A notable example in the U.S. is the Tennessee Eastman plant in Senator Alexander's state. That plant has been operating for more than 20 years using coal instead of natural gas to make chemicals and industrial feedstocks. It also achieves mercury reductions better than 90%.

The electric power industry has been slow to take up gasification technology but two commercial-scale units are operating in the U.S.—in Indiana and Florida. The Florida unit, owned by TECO, is reported by the company to be the most reliable and economic unit on its system. Two coal-based power companies, AEP and Cinergy, have announced their intention to build coal gasification units. In addition to enabling lower-cost CO_2 capture, gasification technology has very low emissions of most conventional pollutants and can achieve high levels of mercury control with low-cost carbon-bed systems.[17]

Methods to capture CO_2 from industrial gas streams have been in use for decades. In the U.S., for example, they are used to separate CO_2 from "sour gas" at natural gas processing plants and are even in use at a few coal-fired power plants to produce CO_2 for sale to the food and beverage industries. In North Dakota, a large coal gasification plant captures CO_2 and ships it by pipeline to an oil field in Saskatchewan, where it is injected to produce additional oil. In Wyoming, a large gas ExxonMobil gas processing plant captures CO_2 for sale to oil field operators in that state and in Colorado. Smaller plants in Texas do the same thing to serve oil fields in the Permian Basin.

While capture methods are commercially mature, they have been designed for smaller scale industrial processes and significant potential for optimization exists when capture is applied to electric power plants. Expanded deployment in commercial plants is the most effective way to improve these systems. However, except to serve a limited market for enhanced oil recovery, capture systems will not be deployed in the U.S. unless limits are placed on CO_2 emissions. Limits such as a cap and trade system will create the market conditions for use and improvement of capture systems much as the adoption of the Clean Air Act in 1970 stimulated the enormous improvement of control systems for conventional pollutants that has occurred in the last three decades.

Once captured, the CO_2 must be disposed of and the currently viable approach is to inject the CO_2 into deep geologic formations that are capable of permanently retaining it. When I first heard of this concept I was skeptical but willing to learn. Since then, based on information in the published literature and many discussions with geologists, I have concluded that geologic storage can be an effective addition to the toolbox of methods we have to cut greenhouse gas emissions. More important than my personal views are the conclusions of many professionals in the field and the practical experience that is growing daily.

Geologic injection of CO_2 has been underway in the U.S. for a couple of decades as a method for producing additional oil from deleting fields. Today, oil companies inject about 30 million tons annually into fields in the Permian Basin, Wyoming, Colorado and other states. Because industrial sources can emit CO_2 for free under current U.S. policy, most of the injected CO_2 is supplied from natural CO_2 reservoirs, rather than being captured from emission sources. Ironically, due to the lack of emission limits and the limited number of natural CO_2 fields, the shortage of CO_2 supply is causing

[17] Methods other than gasification to produce CO_2 "capture-ready" streams under being researched but they are not as ready for commercial deployment as gasification.

many additional opportunities for additional domestic oil production from existing fields to be put on hold. There is, of course, a huge supply of CO_2 from power plants and other sources that would become available to supply this market but that will not happen as long as CO_2 can be emitted at no cost.

Such enhanced oil recovery (EOR) operations are regulated to prevent releases that might endanger public health or safety but they are not monitored with any techniques that would be capable of detecting smaller leak rates. Small leak rates might pose no risk to the local surroundings but over time could undercut the effectiveness of geologic storage as a CO_2 control technique. Especially in EOR operations, the most likely pathways for leakage would be through existing wells penetrating the injection zone.

In addition to these EOR operations, CO_2 is being injected in large amounts in several other projects around the world. The oldest of these involves injection of about 1 million tons per year of CO_2 from a natural gas platform into a geologic formation beneath the sea bed off the coast of Norway. The company decided to inject the CO_2 rather than vent it to avoid paying an emission charge adopted by the Norwegian government—a clear example of the ability of emission policies to produce the deployment of this technology. It is also noteworthy that the CO_2 disposal costs do not cause this gas production venture to be uncompetitive. The Norwegian operation is intensively monitored and the results from over six years of operation indicate the CO_2 is not migrating in a manner that would create a risk of leakage. Other large-scale carefully monitored operations are underway at the Weyburn oil field in Saskatchewan and the In Salah natural gas field in Algeria.

In a functioning cap and trade program where "credit" was being sought for injecting CO_2 into geologic formations, it would be necessary to establish protocols for characterizing sites for long-term retention capability, including issues like well-bore integrity, and for monitoring these injection sites. Various institutions are working on these issues.

In my opinion, while we need additional experience with large-scale injection in various geologic formations, we know enough to expand these activities substantially under careful procedures for site selection, operating requirements and monitoring programs. I believe that the imperatives of avoiding further carbon lock-in and the capabilities of CO_2 capture and storage technologies today warrant policies to deploy these methods at new coal plants without further delay.

We Need Real Policies Now to Send a Real Market Signal.

The electric power sector is the country's and the world's largest emitter of global warming pollution, accounting for 40 percent of CO_2 emissions today. Hence, any solution to global warming must include transforming the sector to produce power with little or no CO_2 emissions. In the bills it passes or fails to pass, this Congress will either stimulate investors to get serious about developing and using new climate-friendly power

technology or send them a signal to procrastinate. For example, including provisions to limit CO_2 in a power plant bill can speed the process of bringing advanced technologies to market; leaving CO_2 out will keep that activity on the back burner.

Some have argued that expanded R&D appropriations or subsidies for deployment of advanced technologies are enough. They are not. Under the current approach, there would be at most one smallish coal gasification plant with CO_2 capture starting operation perhaps 10 years from now IF the project is funded. I refer to the Administration's $1 billion "FutureGen" proposal. Even if this project proceeds, which seems far from certain at this point, it will not provide the range of operational experience that U.S. industry and others around the world will want to have. To stimulate more activity, the private sector must be fully engaged and cost-sharing in one subsidized project is no substitute for a genuine market opportunity. A market for coal gasification with CO_2 capture will be created when the private sector knows that greenhouse gas emitters will have to invest in limiting their emissions. Until Congress makes that clear, the private sector's response will be "wait and see."

But wait and see is a posture we cannot afford. In an analysis done by officials from the U.S. Department of Energy's National Energy Technology Laboratory, the authors concluded that a cost-effective strategy for stabilizing concentrations at 550 ppm would involve applying CO_2 capture and storage systems to 70% of new coal plants starting in 2012.[18] Another study by DOE's Pacific Northwest National Laboratory also concludes that to allow stabilization at either 450 or 550ppm, substantial amounts of U.S. coal capacity would need to be equipped with CCS between now and 2020.[19] A few might argue that we may not need to stabilize at 550 or 450 but if we do not act today to speed up deployment of cleaner technologies, including CCS, we will make those targets impossible. Our current approach is like high-speed tailgating in a snowstorm—it's possible we won't have to stop fast but if we do, we won't be able to. The difference with global warming is that the odds and the consequences are much worse.

Whether in a sector-specific bill for the power sector or a broader bill like that proposed by Senators McCain and Lieberman, the adoption of a schedule for binding limits on CO_2 emissions is essential. By adopting a schedule now, you can provide the maximum lead-time for the industry and achieve long-term reductions at the most gradual rate of change. By providing clarity on when and by how much we will limit carbon emissions you put market forces to work to deliver the clean energy resources we will need to meet economic growth and to provide the stable climate we need to protect our economy, the landscapes we love, and our quality of life.

---

[18] Kuuskraa, V., et al., 2004, "Future U.S. Greenhouse Gas Emission Reduction Scenarios Consistent with Atmospheric Stabilization of Concentrations," presented at 7th International Conference on Greenhouse Gas Control Technologies, Vancouver Canada.

[19] Dooley, J.J., et al., 2005, "Accelerated Adoption of Carbon Dioxide Capture and Storage Within the United States Electric Utility Industry: the Impact of Stabilizing at 450 ppmv and 550 ppmv," ," presented at 7th International Conference on Greenhouse Gas Control Technologies, Vancouver Canada. (revised January 2005).

A viable framework for advancing this technology and protecting against global should include a mandatory schedule for capping and reducing greenhouse emissions over time (applied either to a major sector, such as electric generators, or to all major emitting sectors) combined with a very substantial program of financial support for deployment of low- and zero-emitting energy resources, including new coal plants that capture CO_2 for geologic disposal. A financial support program could be structured to mitigate the impacts on those coal-dependent businesses that might be adversely affected by a pure "carbon price" approach.

Why should you support a program that limits emissions and provides additional incentives for deployment of low-carbon energy resources? First, it should be clear by now that the problem of global warming cannot be made to go away just by denying its existence. The consequences of continued increases in emissions are inexorable and delay will just make the solutions more costly and disruptive. Second, changing the energy system to operate with lower CO_2 emissions can produce huge benefits for the U.S. on a number of fronts. A program that helps us use energy more efficiently, expands the use of renewable energy, and enables coal use without global warming emissions not only will provide enormous environmental and economic benefits by avoiding runaway changes in the climate. These same measures will serve other strategic interests.

Increasing dependence on imported hydrocarbons, in the U.S. and in nearly all major trading nations, poses real threats of economic and political disruption. Efficiency, renewables, and coal without carbon emissions can reduce this import dependence in the U.S. and in every country that employs these methods. In the U.S., industrial gas users are increasingly damaged by price volatility due in part to the continued and growing demand for gas use in the electric sector. The trio of efficiency, renewables, and coal with CO_2 capture and storage can avoid a disruptively tight gas market. Agricultural interests will also gain. U.S. (and European) commodity producers have long enjoyed large subsidies for products like cotton and sugar. But these subsidies are now being challenged successfully before the World Trade Organization (WTO).[20] Renewable energy resources, particularly wind and biomass energy products, promoted by a comprehensive climate protection program, have the promise of becoming a significant, WTO-legal source of new revenues.

Meeting our nation's diverse challenges are powerful reasons for you to support these proposals. We will all benefit in numerous ways from a serious program that combines binding, market-based requirements and financial incentives for deployment of low and carbon-free energy technologies, including those that provide a sustainable role for coal.

---

[20] Benson, Todd 2004. W.T.O. Rules for Brazil in Sugar Dispute, *New York Times,* August 5, Business section; Meller, Paul and Becker, Elizabeth 2004. U.S. Loses Trade Cases and Faces Penalties, *New York Times,* September 1, Business section.

Appendix to NRDC submission for Coal Conference

1. Testimony of John D. Walke, NRDC, on S.131, the "Clear Skies Act of 2005," February 2, 2005.
2. Comments of NRDC, et al., on the Draft Programmatic Environmental Impact Statement ("DEIS") on Mountaintop Removal coal mining and associated valley fills in Appalachia, published at 68 Fed. Reg. 32487 (May 30, 2003), January 6, 2004.