ENVIRONMENTAL JUSTICE LEADERSHIP FORUM ON CLIMATE CHANGE
THE FALLACY OF CLEAN COAL
POLICY POSITION PAPER

OVERVIEW

THE FALLACY OF "CLEAN COAL"

The term "clean coal" is used to refer to burning coal in a way that reduces emissions or otherwise lessons coal's environmental impact. "Clean coal" technology includes "washing" coal of minerals and other polluting components, gasification, and treating flue gases to lesson sulfur dioxide (SO_2), nitrogen oxide (NO_x), and mercury emissions. In the context of climate change, the term "clean coal" is used most frequently as shorthand for technology that makes burning coal more efficient and/or decreases its CO_2 emissions. "Clean coal" continues to have an extremely detrimental environmental impact through mining, water use, worker conditions and deaths, landscape destruction, and the emission of air pollutants with localized effects, including SO_2.

Carbon capture and storage (CCS) is the technology that purports to permit the continued burning of coal without incurring the public health and environmental consequences of associated CO_2 emissions. CCS has three parts: capture, transport, and storage of CO_2. There are three possible ways to capture carbon, but none achieve economic and technological viability. Pre-combustion capture, in which coal is converted into a gas before it is burned and the resulting CO_2 is removed, is efficient in terms of capture but costly to build, and is therefore not widely used.[1] Post-combustion capture, in which CO_2 is removed from plant emissions, is technologically possible but inefficient in terms of capture.[2] CO_2 comprises only 10-12 percent of emissions from coal-fired power plants, and is expensive to isolate.[3] Finally, oxyfuel capture, in which coal is burned in pure oxygen, allows for efficient CO_2 removal but has yet to be operationalized at scale.[4] Despite the multiple potential forms of carbon capture, the necessary technology is not ready for wide scale adoption; even the Department of Energy (DOE), a CCS proponent, admits that it is not cost effective.[5]

If CO_2 could be captured, it would then have to be transported, primarily via pipelines, to storage sites. The Intergovernmental Panel on Climate Change (IPCC) states that CO_2 can be piped up to 1000km.[6] Some pipelines are already in use in the United States,[7] but much more would have to be constructed to transport CO_2 at the necessary scale—requiring a huge upfront investment.[8]

After transport, the captured CO_2 would have to be stored deep underground. Carbon storage is theoretically possible in depleted oil and gas reserves, unmineable coal seams, deep saline aquifers, oil reserves,[9] deep saline reservoirs, and ocean waters or seabeds.[10] Practically, however, many technological and economic barriers remain, limiting its utility as part of the necessary short-term carbon mitigation strategy. The technology has yet to be demonstrated at scale.[11] Moreover, the long-term nature of storage raises concerns about the feasibility of safe sequestration. Technology has yet to demonstrate that carbon could be safely stored for the centuries and millennia required. Even CCS proponents like the IPCC admit its limitations: the panel found that by 2050, only 30-60 percent of CO_2 emissions from electricity generation "*could* be technically suitable for capture."[12] This statistic is revealing: even in the IPCC's best case scenario, in which the plethora of remaining scientific questions are answered to the benefit of CCS development, only a mid-range of CO_2 emissions from the power sector will be eliminated. Putting all other concerns about coal and CCS aside, at best, the technology will be only one part of climate change mitigation. It is not a silver bullet.

THE DEFENSE OF "CLEAN COAL" AS A CLIMATE CHANGE MITIGATION STRATEGY

Despite the lack of science supporting industrial-scale CCS and its limited utility, the technology is still considered by many outside the coal industry to be an important way of reducing CO_2 emissions. The primary reason for CCS' popularity—besides the strong push from coal lobbyists[13]—is coal's abundance and apparent low cost. Coal produces a large percentage of the world's power supply, and probably will continue to do so for the foreseeable future. Coal is particularly abundant in three key countries: the United States, China, and India.[14] The United States, for example, gets more than half its electricity from coal,[15] accounting for almost 40 percent of CO_2 emissions,[16] and a full 78 percent of China's electricity came from coal in 2006.[17]

Coal has historically remained consistently and artificially cheap because the price fails to internalize the totality of the resources extraction, production, and combustion costs. This artificial price gives coal a competitive advantage over more expensive natural gas, oil, and renewable options, despite its many environmental and social costs, which are explored in depth below.

Finally, global coal use continues to expand exponentially each year. China alone builds the equivalent of two coal-fired plants every week, adding the electrical generation capacity of the U.K. each year.[18] These new coal-fired plants, accounting for the recent large increase in global CO_2 emissions,[19] increase the growing country's reliance on coal. India is projected to consume six percent more coal each year, meeting current U.S. usage rates by 2020.[20] The energy demand from modernizing countries like China and India is expected to continue growing unabated into the foreseeable future.

Many believe that unless advances in competitive-cost renewal energy options are developed and widely implemented, the continued and expanded use of coal is inevitable cause of its abundance, low cost, and extensive use by rapidly developing countries. There is evidence to support this belief: A Massachusetts Institute of Technology (MIT) study found that even under a scenario where the world price of carbon is high—and the price of coal reflects this carbon cost—coal use will still increase between 20 and 60 percent, depending on the growth of nuclear power.[21]

Proponents of "clean coal" argue that since coal is such a major contributor to climate change and is likely to remain a important source of electrical power for the foreseeable future, investment in CCS research and development (R&D) is essential. They argue that even if the U.S. stops using coal, India and China will continue to use it to provide for their billions of citizens.[22] As these countries modernize, their per capita energy use is likely to increase dramatically if population and economic growth rates continue to increase unabated. For example, China currently uses only one-fifth of the energy used per capita by developed countries,[23] and India uses only 35 percent of the energy used byChina.[24] These numbers are unlikely to remain static and increased demand for energy is expected to create a concurrent rise in coal use and CO_2 emissions. Ignoring the massive energy needs of China and India is unrealistic, CCS advocates maintain. It is more practical to help these countries use their coal as cleanly as possible instead of imposing unworkable requirements on them.

A sustainable energy future cannot ignore the need the developing world has for increased energy access. Yet, even with this increasing demand, a sustainable just energy policy cannot include “clean coal”.

ENVIRONMENTAL JUSTICE CRITIQUES OF CCS

I. CCS PERPETUATES AND COULD POTENTIALLY INCREASE ENVIRONMENTAL INJUSTICES RELATED TO COAL USE

The term "clean coal" implies that we can keep consuming coal without suffering any detrimental consequences. The costs of the expected consequences of functional CCS belie this implication. There is no such thing as clean coal; burning coal always costs too much.

CCS is advocated as a climate change mitigation strategy because CCS plants do not emit carbon and increase greenhouse gas pollution through that source. This argument ignores the myriad of other environmental impacts associated with CCS and coal use generally. In addition, it fails to acknowledge the social impact that coal has on communities located near its extraction, processing and burning sites. These communities are still subject to the devastating impacts of coal, even when the carbon created by coal is captured and stored.

In fact, the total social and environmental impacts of coal use may *increase* with the use of CCS. Even if CCS eventually reduces carbon emissions from coal-burning plants, the long-term impacts of a shift to CCS technology could have unanticipated and far-reaching impacts on the environment that outweigh the benefits of short-term climate change mitigation. CCS technology is inherently more resource-intensive and expensive than conventional coal use. To work most efficiently, carbon capture needs to utilize pre-combustion technology because the CO_2 released from conventional coal-fired plants is very dilute. Pre-combustion gasification plants, however, consume 25 percent of the energy they produce, requiring that more coal be mined and burned to sell the same amount of energy.[25] Another 20 percent of the energy produced is typically consumed in compressing the CO_2 for storage.[26] CCS also uses 90 percent more fresh water than conventional coal-fired plants.[27] As a result of these inefficiencies, it has been estimated that the adoption of CCS as a primary component of climate change mitigation—as some argue it must be[28]—would require a 33 percent increase in resource consumption and would eliminate improvements in efficiency made in the last 50 years.[29]

Such an increase in coal consumption would negatively impact the communities and ecosystems where coal is mined. The environmental and human costs of coal mining and burning are numerous and well documented.[30] Briefly, they include the contamination of local air and water with pollutants (including mercury, NO_x, SO_2, and particulate matter), the violent destruction of areas containing coal through dynamiting, strip mining, and mountaintop removal, the health risks of black lung disease and mining itself,[31] and the release of methane, a greenhouse gas 20 times more powerful than CO_2. All these would increase with the adoption of CCS.

II. THE COSTS ASSOCIATED WITH CCS ARE TOO HIGH FOR IT TO BE CONSIDERED A VIABLE CLIMATE CHANGE MITIGATION STRATEGY.

A tremendous amount of money and ingenuity would be necessary to make CCS a viable solution at the scale needed (assuming that is even technologically possible).[32] At least a percentage of that cost would inevitably be passed down to consumers, to the particular detriment of low-income communities already suffering from increased energy costs. The true impact of this cost increase is still unknown. The IPCC estimates that CCS could cause electricity prices to increase between 21 and 91 percent.[33]

CCS supporters advocate for continued government subsidizing of CCS R&D and argue that the government should absorb much of the potential resulting liability.[34] This government support would be in addition to the $10 billion (2003 dollars) that the DOE has spent on coal since 1978,[35] and would include increased spending on CCS programs.[36]

The impact that government financial support has on the development and adoption of wide-scale energy technology cannot be understated. As with any government spending, the money that goes toward coal limits the resources available for other energy R&D. The continued absorption of coal's financial costs by the federal government through investment in CCS technology will cause investment in renewable energy and efficiency to suffer.[37] In addition, government investment in CCS restricts financial investments in energy subsidies, green jobs, and efficiency programs that target low-income communities. This unintended consequence is particularly unacceptable for community groups working to position the new "green economy" as a way to bring jobs and resources to un- and underemployed populations. For these groups and others working to improve environmental, public health, and economic equality, a massive shift in government investments is needed to make alternative energy sources viable. Continuing to invest billions in non-renewable energy sources like CCS diverts funds away from new clean technologies and delays full-scale climate change mitigation strategies.

Coal's virtue lies in its reliably low price, say its backers. But that price is rising. The price of two important grades of American coal rose 93 percent and 64 percent between March 2007 and 2008.[38] Americans have thus far been insulated from a corresponding increase in their electricity bills because utilities tend to buy coal through long-term contracts, postponing the need to raise prices.[39] However, electricity bills are expected to begin rising soon: in the summer of 2008, an Ohio utility announced a 45 percent rate hike over the next three years, and the Tennessee Valley Authority released plans to increase energy prices by 10 to 20 percent, leading to a $12 to $25 per month increase in customer bills.[40] Such increases can prove devastating to families already struggling to pay for gas to get to work and food to feed their families. In China, rising coal prices in 2008 have made it more economical for many plants to import coal, and its biggest utilities are loosing money because consumer prices are dictated by state regulation.[41] These changes have supported the development of wind power in the country, which has grown at 100 percent per year since 2005.[42]

Coal's future is far from secure. By building more coal-fired plants of any kind, we are making ourselves dependant on a polluting and unstable source of energy. Renewable and nonpolluting sources, like wind and solar, are available in abundance locally, avoiding the many pitfalls of coal and other carbon-based fuels.

III. CCS STORAGE CREATES UNACCEPTABLE RISKS AND POTENTIAL NEW ENVIRONMENTAL INJUSTICES

CCS includes a multitude of unacceptable high risks beyond those typically associated with coal-fired power plants. These risks arise from the uncertainty and danger associated with long-term carbon storage and include the potential health impacts of abrupt CO_2 escape, contamination of water supplies, ecosystem destruction, and increased CO_2 emissions from leakage.[43] The environmental burden and potential public health calamity caused by carbon storage particularly concern environmental justice communities. These are the communities have historically borne the burden of housing energy facilities, waste sites, and other undesirable land uses and are likely to bear the burdens and risks of CO_2 storage if CCS is implemented.

While geological constraints would play a part in determining storage sites, history indicates that waste disposal facilities are almost always located in or near communities of color and low-income communities. There is no reason to think that CCS facilities will be any different, as wealthier and more powerful communities are likely to organize to ensure CO_2 storage facilities are not located in their neighborhoods. The risks associated with CO_2 storage are real: should CO_2 quickly leak from a storage site, it could asphyxiate residents located nearby. Instances of this event have occurred naturally, such as the 1986 disaster at Lake Nyos in Cameroon.[44] Over a few short hours one night, CO_2 bubbled up from the volcanic-crater lake, killing 1700 people and thousands of animals in the town bordering the lake.[45] Additional public health impacts from CO_2 storage could also occur on a less dramatic scale. For example, surrounding communities would suffer if CO_2 contaminated local drinking water or storage required the destruction of the surrounding environment.

Beyond these real public health risks, potential CO_2 leakage would undermine the entire purpose of CCS plants. The leakage of CO_2 would contribute directly to the climate change CCS is supposed to protect against. Even such a small-scale escape of stored CO_2 might eliminate the gains in CO_2 emissions reductions from CCS.[46] Though the likelihood of such an escape is apparently small, [47] the lack of advanced technology on the subject (as discussed below) leaves this an open question.

Fears about leakage into soil, water, and the atmosphere are bolstered by the United States Geological Survey's study at the Frio Brine pilot project in South Liberty, Texas. The study found that the CO_2 had acidified salty water, which then dissolved surrounding minerals and carbonate materials.[48] This unexpected reaction is concerning because these are the very materials that are supposed to contain the CO_2 for thousands of years. In particular, carbonates are important components of the cement that forms oil and gas wells, one of the potential storage site types.[49]

CCS will require long-term storage monitoring and upkeep. This requirement both increases the cost of the technology and creates a potential environmental justice problem, as communities surrounding the sites located farthest from those who hold power may not have the power or knowledge to ensure proper monitoring and upkeep.

We simply do not—and cannot—understand the long-term consequences of CCS well enough to ensure that disastrous leakage does not occur.[50] These are unacceptable risks to impose on the communities that will inevitably be tapped to house CO_2 storage facilities, and unacceptable long-term risks to require future generations to inherit.

IV. CCS TECHNOLOGY HAS NOT BEEN DEMONSTRATED ADEQUATELY ENOUGH TO MAKE IT A VIABLE ENERGY ALTERNATIVE

While many of the composite parts of CCS technology have been proven on a small-scale, they have yet to be combined on the scale necessary for use at a power plant.[51] Many large-scale pilot projects are needed for CCS to even be considered a viable option.[52]

The DOE has sponsored some small-scale storage pilot projects, including the Frio Brine Pilot discussed above. The seven Regional Partnerships formed with the DOE as part of the Carbon Sequestration Core Program have proposed 25 pilot projects of comparable size to test storage in different types of formations.[53] However, the MIT study condemns these projects as inadequate to demonstrate CCS's viability.[54]

The largest planned research and implementation CCS project was the FutureGen plant, located in Mattoon, Illinois. This plant, first announced by President Bush in 2003, was supposed to be the first large-scale, near-zero emissions coal-fired power plant in the country. Between 2003 and 2007, the federal government invested $40 million in the plant.[55] This was in addition to the $10 million invested by private funders. Despite this significant investment, the federal government abruptly pulled all funding for the project in early 2008 when costs ballooned to $1.8 billion.[56] The plant has been sidelined indefinitely.

A smaller project met a similar demise the same year in New York. Citing cost concerns similar to those experienced at FutureGen, the New York Power Authority (NYPA) withdrew its support for an upstate New York gasification and CCS plant in July 2008.[57] The plant, known as the Huntley project, would have required billions of dollars in government subsidies over the next 20 years to produce price-competitive power.[58] In addition to the large and potentially increasing costs, NYPA was concerned about backing a project reliant on untested technology and undetermined regulations and liability.[59] Other CCS-related projects were canceled in 2008 as well, further decreasing the likelihood that the technology will be ready to mitigate climate change in the time needed.[60]

The failure of the government and industry to create any adequate demonstration project reveals the true state of CCS technology: it is a pipe dream advanced by those with a stake in coal's survival and those who fail to recognize its inherent limitations. Continuing to invest federal funds in these schemes only serves to distract from the necessary climate mitigation measures that can be achieved through clean, renewable energy sources.

V. IT IS EXTREMELY UNLIKELY THAT LARGE-SCALE CCS WILL BE AVAILABLE AT A COMPETITIVE COST IN THE NEAR FUTURE

Predictions for the widespread availability of CCS technology range from 2020 to 2030 as the earliest likely years of implementation.[61] Even the Electric Power Research Institute, an industry group, does not claim that they will have completed large-scale tests for another 12 years, admitting that even that is a "very aggressive target."[62] All projections may be overly optimistic because of the current insufficiency of scientific knowledge. For example, the MIT study states that while there is a tremendous amount of potential geo-storage formations, there remains a dearth in our knowledge of their quality.[63] As a result, estimates of storage availability, potential, and capacity "are based on vastly simplifying assumptions about the overall rock volume."[64]

As has been documented, the time lag in the implementation of CCS is only one of many problems. Even if commercially-viable CCS technology became available, its adoption would require extensive government regulation addressing the injection of CO_2, how CO_2 reductions are measured and tracked, and site monitoring and closure.[65] Although the Environmental Protection Agency has commenced this process,[66] final rules are still years away. In addition, liability for CO_2 transport and storage must be established. The current lack of clarity, and the ad hoc project-by-project approach, has limited business investment in CCS.[67] Establishing such regulations—especially for such a high-risk technology—is a time-intensive project that further postpones the date when CCS might become available.

The potential multi-decade lag in the implementation of CCS fails to respond to the immediacy of global emissions reductions necessary to mitigate climate change. To avoid climate change's worst possible impacts we must start significantly reducing greenhouse gas emissions by 2015.[68] Even if the technological deficiencies of CCS are overcome and appropriate regulations created, it will not be practical in time to be a reliable climate mitigation strategy.[69]

POLICY RECOMMENDATIONS FOR "CLEAN COAL"

I. A MORATORIUM SHOULD BE PLACED ON THE CONSTRUCTION OF ALL NEW COAL-FIRED POWER PLANTS.

Regardless of the dubious viability of CCS technology in climate change's timeframe, coal is too environmentally and socially expensive to make it an acceptable source of power. The uncertain cost of coal and carbon also makes it financially indefensible. These costs have lead to increasing political and business resistance to coal.[70] For example, concern about the future price of CO_2 emissions caused Kansas Governor Kathleen Sebelius to veto a bill that would have allowed the construction of two more coal-fired plants in the state.[71] NASA scientist Jim Hansen has argued that no more coal-fired plants should be built, and existing ones will soon have to be bulldozed.[72] All U.S. policy makers should be equally forward thinking and responsible by prohibiting the construction of new plants.

Future retrofits of newly constructed coal-fired plants add to the costs associated with CCS technology. New power plants are being built under the guise of being "capture ready"—an unspecified term used to justify building more dirty coal-fired plants that will continue to pollute our air and water for years to come.[73] These CO_2-spewing plants will have to be retrofitted with CCS technology in the future, an inefficient and costly process that will increase the cost of CO_2 emissions reductions by $10 to $15 per ton over already expensive new CCS plants[74] and require the mining and burning of yet more coal. The significant additional costs that this will impose on both plants and consumers are likely to keep most conventional plants from ever being retrofitted.[75]

To truly transition away from a coal-based energy economy, a moratorium must be placed on the construction of all new coal-fired power plants. Continued construction of these plants only serves to further our dependence on coal as an energy source. Moreover, continued construction of coal plants elongates the exposure of communities to environmental injustices, including the public health impacts resulting from co-pollutant emissions, the environmental and social destruction attendant with coal extraction and the long-term, global impact of unabated carbon emissions. Coal cannot extend its life by clinging to an unproven, financially prohibitive technology that is unlikely to be implemented at the broad scale suggested by the coal industry.

We must recognize the limitations, fallacies and injustices associated with CCS and halt the construction of all new coal-fired power plants.

II. INVESTMENT SHOULD BE SHIFTED TO PROVEN CLIMATE CHANGE MITIGATION STRATEGIES INCLUDING ENERGY EFFICIENCY AND RENEWABLE POWER.

True climate change mitigation strategies, such as energy efficiency and renewable power, make more coal power plants unnecessary. A 2007 study by the consulting firm McKinsey and Co. found that improvements in energy efficiency combined with the expansion of renewable energy could eliminate the need for new carbon-fuel plants.[76] Efficiency improvements in commercial and residential buildings alone could eliminate 70 percent of the increased energy demand forecast by the government.[77] These efficiency measures could be implemented without cost or at a profit, making them far more cost effective and investment-friendly than CCS or conventional coal.[78]

Moreover, many of efficiency measures have a proven and impressive track record, unlike CCS. For example, through state efficiency incentives and regulations, electricity demand in California has remained steady while demand throughout the rest of the country has grown by 60%.[79]

Energy efficiency and renewable power offer a cost effective, proven, and nonpolluting way to address climate change immediately. Government investment in renewable, clean energy sources would demonstrate that it takes climate change seriously and is committed to mitigating its impacts on public health, the economy, and the environment in a substantive way. Continuing to invest limited public resources in unproven and dangerous technology such as CCS harms the American public and the larger global populace.

III. THE FEDERAL GOVERNMENT SHOULD UNDERTAKE A FEASIBILITY STUDY OF CCS AS A CLIMATE CHANGE MITIGATION STRATEGY IN THE NECESSARY TIMEFRAME AND INVEST ACCORDINGLY.

This study must be balanced and include a consideration of the environmental justice impacts of all stages of coal use – particularly mining and burning. Should such a study reveal, as we believe, that CCS will not be useful in these next critical years, all federal coal subsidies should cease and be redirected to energy efficiency and renewable power. Even if such a study shows that government investment in CCS for long-term climate change mitigation makes sense, the government should devote equal or greater funds to energy efficiency and renewable power. In addition, any subsidies for coal technologies should be matched by an equal investment in the communities forced to host mining, power plants, and carbon storage facilities.

IV. THE FEDERAL GOVERNMENT SHOULD CHARGE POLLUTING FACILITIES FOR CARBON EMISSIONS WHILE IMPLEMENTING REGULAR ENVIRONMENTAL REVIEWS TO ENSURE THAT ADEQUATE CARBON REDUCTIONS ARE BEING ACHIEVED.

A environmentally and economically just climate change solution must both reduce greenhouse gases and ensure that those facilities contributing to climate change are required to pay for their emissions. Implementing a carbon charge on polluting facilities while providing for regular environmental review of facilities emissions to ensure that adequate carbon reductions are being achieved. The combination of these two mechanisms will ensure that the most economically efficient ways to reduce GHGs are adopted. Please see the Environmental Justice Leadership Forum on Climate Change's policy paper *Carbon Charge Proposal* for further explanation of this equitable and efficient carbon reduction policy mechanism.

V. THE FEDERAL GOVERNMENT SHOULD REVISE REGULATIONS ON COAL-FIRED POWERPLANTS TO ADDRESS ENVIRONMENTAL JUSTICE CONCERNS AS QUICKLY AS POSSIBLE.

Addressing the environmental justice impacts of coal power plants necessitates more than preventing false solutions like CCS and curtailing the increased use of coal through limiting new power plant construction. The lifespan of power plants causes these energy sources to create multi-generational public health, environmental and social burdens that are impacting communities now and will continue impacting them into the foreseeable future.

In light of these existing burdens, regulations governing coal-fired power plants should be revised to incorporate environmental justice into their operations. The first step in creating such regulations would be opening up regulatory revisions to public comment by the local communities that are most impacted by coal use and coal plants. These communities house thousands of "local experts" who would be able to provide the regulating agencies with suggestions on how to best incorporate environmental justice into the regulatory language.

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[1] Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 5 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf (pre-combustion technology is currently utilized in fertilizer manufacturing and hydrogen production).

[2] The Intergovernmental Panel on Climate Change (IPCC) report on CCS states that post-combustion capture is "economically feasible under specific conditions," meaning that the technology has been operationalized and is understood, and could be cost effective in the correct regulatory setting. However, it seems doubtful that such a regulatory regime will be adopted in enough time to effectively mitigate climate change. Post-combustion CO2 capture is used in the natural gas processing industry. Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 5 (2005), http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf.

[3] U.S. DEP'T OF ENERGY, CARBON CAPTURE RESEARCH (2007), http://www.fossil.energy.gov/programs/sequestration/capture/index.html.

[4] Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 5 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf.

[5] U.S. DEP'T OF ENERGY, CARBON CAPTURE RESEARCH (2007), http://www.fossil.energy.gov/programs/sequestration/capture/index.html (the DOE states that "existing capture technologies . . . are not cost-effective when considered in the context of sequestering CO2 from power plants").

[6] Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 5 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf.

[7] 2500 km of CO2 pipelines currently exist in the United States, transporting 40MtCO2/year[0]. Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 5 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf.[0]

[8] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 12 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing P. RAGDEN ET AL., FEDERAL ENVIRONMENTAL AGENCY, *TECHNOLOGIES FOR CO2 CAPTURE AND STORAGE*, *SUMMARY*, F.R.G. 18 (2006)).

[9] Storing CO2 in oil reserves is called Enhanced Oil Recovery (EOR) because it supports oil flow by maintaining pressure. EOR thereby partially offsets the cost of CCS. U.S. DEP'T OF ENERGY, CARBON CAPTURE RESEARCH (2007), http://www.fossil.energy.gov/programs/sequestration/capture/index.html. However, EOR's financial impact is questionable, because potential EOR projects are too limited in size and number to make a significant dent in CCS' substantial cost. [9] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 14 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing *Carbon Sequestration Technologies: Hearing Before the S. Subcomm. on Science, Technology, and Innovation, S. Comm. on Commerce, Science, and Transportation*, 110th Cong. (2007) (statement of Dr. Bryan Hannegan, Vice President, Environment Electric Power Research Institute)).

[10] Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 3 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf.

[11] Matthew L. Wald, *The Energy Challenge: Mounting Costs Slow the Push for Clean Coal*, N.Y. TIMES, May 30, 2008, *available at* http://www.nytimes.com/2008/05/30/business/30coal.html?scp=1&sq=%22clean%20coal%22&st=cse. The IPCC states that, under "specific conditions," storage in oil and gas fields and saline formations have been shown to be "economically feasible" by the oil and gas industry. Storage in coal beds has not been demonstrated. Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage,*

Summary For Policymakers, at 6 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf.
[12] Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 9 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf (italics added).
[13] For example, the first two quarters of 2008, the American Coalition for Clean Coal Electricity spent $4,650,759 on lobbying. CENTER FOR RESPONSIVE POLITICS, ALTERNATE ENERGY PRODUCTION & SERVICES, http://www.opensecrets.org/lobby/induscode.php?lname=E1500&year=2008.
[14] The United States, China, Russia, and India have the largest proven coal reserves. BRITISH PETROLEUM, BP STATISTICAL REVIEW OF WORLD ENERGY, JUNE 2008 32 (2008), *available at* http://www.bp.com/sectiongenericarticle.do?categoryId=9023784&contentId=7044480).
[15] U.S. DEP'T OF ENERGY, COAL (2007), http://www.energy.gov/energysources/coal.htm.
[16] SIERRA CLUB, THE DIRTY TRUTH ABOUT COAL: WHY YESTERDAY'S TECHNOLOGY SHOULD NOT BE PART OF TOMORROW'S ENERGY FUTURE 3 (2007), *available at* http://www.sierraclub.org/coal/dirtytruth/report/ (citing U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005* (2007)). The DOE states that 30 percent of carbon emissions come from power plants and other large point sources. U.S. DEP'T OF ENERGY (2007), SEQUESTRATION, http://www.fossil.energy.gov/programs/sequestration/overview.html.
[17] WORLD COAL INSTITUTE, COAL FACTS 2007, http://www.worldcoal.org/pages/content/index.asp?PageID=188.
[18] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD ix (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[19] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 63 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[20] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 74 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf (citing PLANNING COMM'N OF GOV'T OF INDIA, DRAFT REPORT OF THE EXPERT COMMITTEE ON INTEGRATED ENERGY POLICY (2005), http://planningcommission.nic.in/reports/genrep/intengpol.pdf).
[21] The "High CO2 Price" tested was $25/ton of CO2 emitted starting in 2015 and a four percent increase per year thereafter.[21] MIT found that this pricing would make CCS technology cost effective enough that CO2 emissions from coal would decrease from between 50 to 67 percent. MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 95 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[22] For example, the World Bank justified funding a huge conventional coal-fired plant in India because the country "faces power shortages that leave more than 400 million people without access to electricity, mainly in poor rural areas. The country needs to expand generation capacity by 160,000 megawatts over the next decade, and this new project helps address this gap." Quoted in Andrew C. Revkin, *Money for India's 'Ultra Mega' Coal Plants Approved*, N.Y. TIMES, Apr. 9, 2008, *available at* http://dotearth.blogs.nytimes.com/2008/04/09/money-for-indias-ultra-mega-coal-plants-approved/.
[23] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 64 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[24] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 74 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[25] TIM FLANNERY, THE WEATHER MAKERS: HOW MAN IS CHANGING THE CLIMATE AND WHAT IT MEANS FOR LIFE ON EARTH 252 (Atlantic Monthly Press 2005).
[26] TIM FLANNERY, THE WEATHER MAKERS: HOW MAN IS CHANGING THE CLIMATE AND WHAT IT MEANS FOR LIFE ON EARTH 253 (Atlantic Monthly Press 2005).
[27] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 6 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing ERIK SHUSTER ET AL., NATIONAL ENERGY TECHNOLOGY LABORATORIES ESTIMATING FRESHWATER NEEDS TO MEET FUTURE THERMOELECTRIC GENERATION REQUIREMENTS, DOE/NETL-400/2007/1304, at 60 (2007), *available at* www.netl.doe.gov/.../coalpower/ewr/pubs/2007%20Water%20Needs%20Analysis%20-%20Final%20REVISED%205-8-08.pdf .

[28] *See* NATIONAL RESOURCES DEFENSE FUND, CLIMATE FACTS: RETURN CARBON TO THE GROUND 2, *available at* www.nrdc.org/globalwarming/coal/return.pdf ("Long-term geological disposal of CO2 (for thousands of years) is viable now and must be implemented quickly if we are to meet the challenge of sharply reducing global emissions this century"); MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD x (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf ("We conclude that CO2 capture and sequestration (CCS) is the critical enabling technology that would reduce CO2 emission significantly while also allowing coal to meet the world's pressing energy needs"). The National Resources Defense Fund received $437,500 from the Joyce Foundation to "promote alternative plants using coal gasification with carbon sequestration." The Joyce Foundation, http://www.joycefdn.org/Programs/Environment/GrantDetails.aspx?grantId=29414.

[29] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 5 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing P. RAGDEN ET AL., FEDERAL ENVIRONMENTAL AGENCY, TECHNOLOGIES FOR CO2 CAPTURE AND STORAGE, SUMMARY, F.R.G. 24 (2006)).

[30] *See* SIERRA CLUB, THE DIRTY TRUTH ABOUT COAL: WHY YESTERDAY'S TECHNOLOGY SHOULD NOT BE PART OF TOMORROW'S ENERGY FUTURE 5-15 (2007), *available at* http://www.sierraclub.org/coal/dirtytruth/report/.

[31] Jeff Biggers, *'Clean' Coal? Don't Try to Shovel That*, WASHINGTON POST, Mar. 2, 2008, at B02, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2008/02/29/AR2008022903390.html.

[32] The DOE's website admits to the current high price of CCS and states their ambitious goal: "Using present technology, estimates of sequestration costs are in the range of $100 to $300/ton of carbon emissions avoided. The goal of the program is to reduce the cost of carbon sequestration to $10 or less per net ton of carbon emissions avoided by 2015." U.S. DEP'T OF ENERGY, SEQUESTRATION (2007), http://www.fossil.energy.gov/programs/sequestration/overview.html.

[33] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 5 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers* 40 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf.

[34] *See* MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 102-03 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf (finding that the DOE's CCS program is inadequate "because the level of funding falls far short of what will be required").

[35] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 78 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf (in 2003 dollars).

[36] The DOE Carbon Sequestration Core Program was started in 1999. MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 81 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf. President Bush's 2009 budget proposal increases federal coal research 41 percent to $818 million. Of that, $400 million will go towards CCS research and $241 will fund demonstration projects. Green Car Congress, *Proposed Department of Energy Budget for 2009 Boosts Coal, Nuclear, Science and Biomass Programs; Reduces H2, Solar and Vehicle Technology Funding*, Feb. 4, 2008, http://www.greencarcongress.com/2008/02/proposed-depart.html (citing Office of Management and Budget, *Department of Energy,* http://www.whitehouse.gov/omb/budget/fy2009/energy.html).

[37] Such perverse investment priorities are seen in the DOE's budget: the DOE will spend 41 percent more on coal research and 28 percent less on its Energy Efficiency and Renewable Energy (EERE) program. Green Car Congress, *Proposed Department of Energy Budget for 2009 Boosts Coal, Nuclear, Science and Biomass Programs; Reduces H2, Solar and Vehicle Technology Funding*, Feb. 4, 2008, http://www.greencarcongress.com/2008/02/proposed-depart.html (citing Office of Management and Budget, Department of Energy, http://www.whitehouse.gov/omb/budget/fy2009/energy.html). Only about a third of the EERE budget goes towards energy efficiency in buildings and development of renewable power sources. Much of the rest funds biofuel and hydrogen research. U.S. DEP'T OF ENERGY, FY 2009 DOE BUDGET REQUEST TO CONGRESS, BUDGET HIGHLIGHTS (2008), http://www.cfo.doe.gov/budget/09budget/start.htm#Summary%20Budget%20Documents.

[38] Clifford Krauss, *An Export in Solid Supply*, N.Y. TIMES, Mar. 19, 2008, *available at* http://www.nytimes.com/2008/03/19/business/19coal.html?scp=6&sq=coal%20prices&st=cse (citing increases in

the price of coal from central Appalachia and Wyoming). Increases in prices are attributed to a confluence of bad weather and increasing world demand. *Id.*

[39] Clifford Krauss, *An Export in Solid Supply*, N.Y. TIMES, Mar. 19, 2008, *available at* http://www.nytimes.com/2008/03/19/business/19coal.html?scp=6&sq=coal%20prices&st=cse.

[40] David Roberts, *First as Tragedy, Then as Farce? Coal Electricity Prices: the New Gas Prices*, GRIST.ORG, Aug. 8, 2008, http://gristmill.grist.org/story/2008/8/6/164951/7647 (citing Associated Press, *AEP Needs to Hike Ohio Rates 45 Pct Over 3 Years*, cnbc.com, July 31, 2008, *available at* http://www.cnbc.com/id/25948836/for/cnbc and The Bowling Green Daily News, *Electricity Customers Likely to See Big Rate Hike*, BOWLING GREEN DAILY NEWS, Aug. 7, 2008, *available at* http://www.energycentral.com/centers/news/daily/article_share.cfm?aid=78462801**.**

[41] Jonathan Watts, *Energy in China: 'We Call it the Three Gorges of the Sky. The Dam There Taps Water, We Tap Wind*,' GUARDIAN (U.K.), July 25, 2008, *available at* http://www.guardian.co.uk/environment/2008/jul/25/renewableenergy.alternativeenergy.

[42] Jonathan Watts, *Energy in China: 'We Call it the Three Gorges of the Sky. The Dam There Taps Water, We Tap Wind*,' GUARDIAN (U.K.), July 25, 2008, *available at* http://www.guardian.co.uk/environment/2008/jul/25/renewableenergy.alternativeenergy.

[43] [43] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 7 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture.

[44] The MIT study states that the likelihood of a leak on the scale of the Lake Nyos disaster is "exceedingly small." MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 67 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.

[45] Peter J. Baxter, M. Kapila, and D. Mfonfu, *Lake Nyos Disaster, Cameroon, 1986: the Medical Effects of Large Scale Emission of Carbon Dioxide?*, 298 BRIT. MED. J. 1437 (1989), *available at* *http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1836556*.

[46] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 7 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing Christian Azar, *Carbon Capture and Storage from Fossil Fuels and Biomass – Costs and Potential Role in Stabilizing the Atmosphere*, 74 CLIMACTIC CHANGE 47-79 (2006)).

[47] The MIT study found that it is "very likely" that over 99 percent of stored CO2 will remain below ground over 100 years, and "likely" that the same percentage will remain for 1000 years. MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 44 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf (Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage* (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf).

[48] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 26 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing Yousif Kharaka, *Gas-Water-Rock Interactions in Frio Formation Following CO_2 Injection: Implications for the Storage of Greenhouse Gases in Sedimentary Basins*, 34 GEOLOGY 577-580 (2006)).

[49] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 26 (2008) *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture.

[50] The MIT study indicates the limitations of current scientific knowledge: "[T]he state of science today cannot provide quantitative estimates of their likelihood," though the experience we do have indicates the risks are small. MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 50 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.

[51] Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymaker,* at 8 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf ("There is relatively little experience in combining CO2 capture, transport, and storage into a fully integrated CCS system. The utilization of CCS for large-scale power planets (the potential application of major interest) still remains to be implemented"). There are three "industrial size" storage projects in operation (meaning at least 1MtCO2/year): the Sleipner [0]project in Norway (offshore saline formation), the Weyburn EOR project in Canada, and the In Salah gas field in Alergia. *Id.* at 7.

[52] THE PEW CENTER ON GLOBAL CLIMATE CHANGE, COAL AND CLIMATE CHANGE FACTS, *available at* http://www.pewclimate.org/global-warming-basics/coalfacts.cfm (calling for 10 to 30 differently configured commercial-scale CCS demonstration projects as well as storage projects in a variety of geographical settings).
[53] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 53 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[54] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 53 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf (stating that they are "too small to reach key thresholds within the crust").
[55] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 53 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[56] Matthew L. Wald, *The Energy Challenge: Mounting Costs Slow the Push for Clean Coal*, N.Y. TIMES, May 30, 2008, *available at* http://www.nytimes.com/2008/05/30/business/30coal.html?scp=1&sq=%22clean%20coal%22&st=cse.
[57] Patrick Fanelli, *NYPA Withdraws Support For North Tonawanda Clean Coal Project*, POST-JOURNAL, July 17, 2008, *available at* http://post-journal.com/page/content.detail/id/506685.html?nav=5018&showlayout=0.
[58] David Robinson, *Huntley Dream was Just Too Speculative*, BUFFALO NEWS, July 20, 2008, *available at* http://www.buffalonews.com/businesstoday/localbusiness/story/395674.html.
[59] The Huntley project would have sequestered three times as much CO2 than the largest current project in Norway, and would have combined gasification and CCS for the first time. Daniel Pye, *Lack of Support Doomed Huntley*, TONAWANDA NEWS, July 16, 2008, *available at* http://www.tonawanda-news.com/local/local_story_198235404.html.
[60] Projects in five states were canceled or stalled during the first half of 2008. Matthew L. Wald, *The Energy Challenge: Mounting Costs Slow the Push for Clean Coal*, N.Y. TIMES, May 30, 2008, *available at* http://www.nytimes.com/2008/05/30/business/30coal.html?scp=1&sq=%22clean%20coal%22&st=cse.
[61] JON CREYTS ET AL., MCKINSEY & CO., REDUCING U.S. GREENHOUSE GAS EMISSIONS: HOW MUCH AT WHAT COST? 26 (2007), *available at* http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp (stating that CCS "is not expected to be commercially viable for large scale deployment until 2020"); EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 5 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing WORLD BUSINESS COUNCIL FOR SUSTAINABLE DEVELOPMENT, FACTS AND TRENDS- CARBON CAPTURE AND STORAGE (2006), *available at* http://www.wbcsd.org/web/publications/facts&trends-ccs.pdf (stating that CCS technology will not be available for 20 years).
[62] Matthew L. Wald, *The Energy Challenge: Mounting Costs Slow the Push for Clean Coal*, N.Y. TIMES, May 30, 2008, *available at* http://www.nytimes.com/2008/05/30/business/30coal.html?scp=1&sq=%22clean%20coal%22&st=cse.
[63] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 45 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf (citing P.D. Bergman, and E.M. Winter, *Disposal of Carbon Dioxide in Aquifers in the US*, 36 ENERGY CONVERSION & MGMT. 523-26, 523 (1995) and J.J. Dooley and S.J. Friedmann, *A Regionally Disaggregated Global Accounting of CO2 Storage Capacity: Data and Assumptions*, Pacific Northwest National Laboratory, Report PNWD-3431 (2004)).
[64] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 45 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[65] MASSACHUSETTS INSTITUTE OF TECHNOLOGY, THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 55-56 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.
[66] Matthew L. Wald, *Rule Drafted for Carbon Trapping*, N.Y. TIMES, July 16, 2008, *available at* http://www.nytimes.com/2008/07/16/washington/16carbon.html?_r=1&scp=1&sq=carbon%20sequestration,%20new%20york&st=cse&oref=slogin (discussing the EPA's first draft of rules on carbon storage under the Clean Water Act).
[67] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 7 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture (citing International Energy Agency Clean Coal Centre, http://www.iea-epl.co.uk/content/default.asp?PageID=885). For example, a state representative explained New York's recent pullout of the Huntley project (see below), as due in part to the lack of regulation and a clear liability system:

"Carbon capture and sequestration regulations do not exist, and therefore legislation ought to be adopted to enable permitting a facility…Liability and regulatory protocols are needed for site selection, injection operation and monitoring, and custody of captured carbon dioxide.'" Patrick Fanelli, *NYPA Withdraws Support For North Tonawanda Clean Coal Project*, POST-JOURNAL, July 17, 2008, *available at* http://post-journal.com/page/content.detail/id/506685.html?nav=5018&showlayout=0 (quoting New York Power Authority representative Donald Russak).

[68] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 5 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture. Rajendra Pachauri, chairman of the IPCC stated in November, 2007 that "[i]f there's no action before 2012, that's too late." Elisabeth Rosenthal, *U.N. Report Describes Risks of Inaction on Climate Change*, N.Y. TIMES, Nov. 17, 2007, *available at* http://www.nytimes.com/2007/11/17/science/earth/17cnd-climate.html?_r=3&hp=&adxnnl=1&adxnnlx=1195319084-Jdx9pxVCIloHheE9QTud/A&pagewanted=print&oref=slogin&oref=slogin.

[69] The IPCC estimates that 30-60 percent of CO2 emissions from electricity generation and 20-40 percent of emissions from fossil fuels overall "*could* be technically suitable for capture" by 2050. Working Group III of the Intergovernmental Panel on Climate Change, *IPCC Special Report: Carbon Dioxide Capture and Storage, Summary For Policymakers*, at 9 (2005), *available at* http://arch.rivm.nl/env/int/ipcc/pages_media/SRCCS-final/SRCCS_SummaryforPolicymakers.pdf (italics added). Since avoiding the worst impacts of climate change requires decisive action in the next few years, CCS should only be viewed as a possible and partial strategy for long-term climate stability.

[70] In April 2008, the Earth Policy Institute compiled a list of setbacks to coal-fired power since early 2007. These include: a Washington State bill and a Florida Executive Order that effectively create moratoriums on the construction of coal-fired plants in those states; Citigroup and Merrill Lynch's decision to downgrade coal stocks; several investment banks' announcement that funding of coal-fired plants would require that utilities' demonstrate economic viability in the presence of a carbon charge; Senate Majority Leader Harry Reid's opposition to the construction of coal-fired plants in any country; and the introduction of a bill by Representatives Henry Waxman and Edward Markey that would ban the permitting of any non-CCS plant. LESTER R. BROWN AND JONATHAN G. DORN, EARTH POLICY INSTITUTE, THE BEGINNING OF THE END FOR COAL: A LONG YEAR IN THE LIFE OF THE U.S. COAL INDUSTRY, Apr. 2, 2008, http://www.earth-policy.org/Updates/2008/Update70_timeline.htm. Political and business resistance to coal power has translated into opposition to and the abandonment of many construction plans: 59 of the 151 coal-fired plants proposed during 2007 were canceled during that year; another 50 were challenged in the courts. LESTER R. BROWN, EARTH POLICY INSTITUTE, U.S. MOVING TOWARD BAN ON NEW COAL-FIRED POWER PLANTS, Feb. 14, 2008, http://www.earth-policy.org/Updates/2008/Update70.htm.

[71] Felicity Barringer, *Kansas Governor Vetoes Bill to Revive 2 Coal-Fired Power Plants*, N.Y. TIMES, Mar, 22, 2008, *available* at http://www.nytimes.com/2008/03/22/us/22kansas.html?scp=2&sq=%22Kathleen%20Sebelius%22%20coal&st=cse.

[72] James Hansen, *Why We Can't Wait*, NATION, Apr. 19, 2007, *available at* http://www.thenation.com/doc/20070507/hansen (adapted from a speech Jim Hansen gave to the National Press Club on February 26, 2007).

[73] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 5 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture.

[74] JON CREYTS ET AL., MCKINSEY & CO., REDUCING U.S. GREENHOUSE GAS EMISSIONS: HOW MUCH AT WHAT COST? 61 (2007), *available at* http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp.

[75] EMILY ROCHON ET AL., GREENPEACE INTERNATIONAL, FALSE HOPE: WHY CARBON CAPTURE AND STORAGE WON'T SAVE THE CLIMATE 19 (2008), *available at* http://www.greenpeace.org/usa/press-center/reports4/false-hope-why-carbon-capture.

[76] JON CREYTS ET AL., MCKINSEY & CO., REDUCING U.S. GREENHOUSE GAS EMISSIONS: HOW MUCH AT WHAT COST? 23-25 (2007), *available at* http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp "Pursuing energy efficiency in electric power…has the potential to reduce the number of new coal-fired power plants needed (as projected by the Department of Energy) through 2030. Renewable energy sources that come after energy efficiency gains could enjoy the same comparative benefits—up to the point where the projected new-build plants are completely eliminated"). Significant additional CO2 emissions reduction will likely be profitable during this period

as the McKinsey study is based on Energy Information Administration (EIA) data. EIA predict that the price of oil will be $60/barrel on average through 2030, a number made out of date by the 2008 increases. *Id.* at 25.

[77] JON CREYTS ET AL., MCKINSEY & CO., REDUCING U.S. GREENHOUSE GAS EMISSIONS: HOW MUCH AT WHAT COST? 34 (2007), *available at* http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp.

[78] JON CREYTS ET AL., MCKINSEY & CO., REDUCING U.S. GREENHOUSE GAS EMISSIONS: HOW MUCH AT WHAT COST? 21 (2007), *available at* http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp. The range given depends on the levels of government incentives, research and development of technologies, and other factors. The report notes that these cost-saving or cost-neutral measures are not currently taken because of mismatches in incentives, lack information, and other "market inefficiencies." In total, 1.3 to 2.0 gigatons of CO2 emissions could be eliminated by 2030 at cost or at a profit. These savings are in energy efficiency, not in large-scale uncertain investments like CCS. *Id.*

[79] Joseph Romm, *Why We Never Need to Build Another Polluting Power Plant*, SALON.COM, July 28, 2008, http://www.salon.com/news/feature/2008/07/28/energy_efficiency/print.html#--Really. Improvements in energy efficiency could minimize the energy sector's reliance on coal: "A 2007 report from the international consulting firm McKinsey and Co. found that improving energy efficiency in buildings, appliances and factories could offset almost all of the projected demand for electricity in 2030 and largely negate the need for new coal-fired power plants." *Id.* (citing JON CREYTS ET AL., MCKINSEY & CO., REDUCING U.S. GREENHOUSE GAS EMISSIONS: HOW MUCH AT WHAT COST? (2007), *available at* http://www.mckinsey.com/clientservice/ccsi/greenhousegas.asp).